



# Surgery, Gynecology and Obstetrics

An International Magazine  
Published Monthly

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Volume XXIV  
January to June 1917

PUBLISHED BY  
THE SURGICAL PUBLISHING COMPANY OF CHICAGO  
30 NORTH MICHIGAN AVENUE CHICAGO

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THE SURGICAL PUBLISHING COMPANY  
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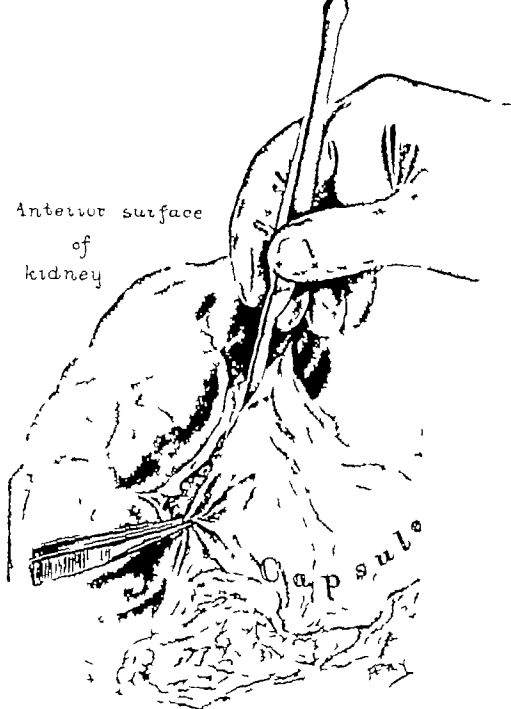


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Anterior surface  
of  
kidney



The Subcapsular dissection for perinephric dissection of the kidney  
The Subcapsular dissection for perinephric dissection of the kidney

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

VOLUME XXX

JANUARY 1917

NUMBER I

## THE REMOVAL OF STONES FROM THE KIDNEY<sup>1</sup>

By WILLIAM J. MAYO, M.D., ROCHESTER, MINNESOTA

FROM January 1, 1898 to December 31, 1915 450 patients with stone in the kidney were operated on in the Clinic (484 operations). Three died a mortality of 0.6 per cent. This percentage represents the number of patients who died in the hospital without regard to cause of death or length of time after operation. The results achieved were due more to the painstaking care with which the diagnoses were made, the function of the kidney estimated and the patients prepared for operation than to any purely technical feature of the procedures employed in removing the stones.

The presence of the stones was shown by the roentgenogram. By means of the pyelogram the urologist was able to say with certainty whether the stone was in the pelvis, calyx or parenchyma of the kidney. On two occasions previous to the use of the pyelogram I exposed the right kidney on the basis of roentgenographic shadows only to find it free from disease and the stones which had given rise to the shadows located in the gall bladder directly anterior to the kidney. It is true that these shadows can usually be identified as gall stones by their concentric layers and density but as Carman points out in occasional shadow may be confusing.

*Stones in both kidneys.* Forty-eight patients (9.9 per cent) had stones in both kidneys. A kidney containing small movable stones is more liable to exacerbations of infection, the result of temporary obstruc-

tion than a kidney containing large stones. The large stones because of their more or less fixed condition may not interfere with drainage and therefore may be the cause of comparatively few symptoms even though the kidney is extensively damaged. Unless the condition in the opposite side is acute our practice has been to remove the stone from the least involved kidney first, the second kidney being operated on after the patient has recovered from the first operation usually 10 to 14 days later.

Occasionally the second kidney has considerable function even when it contains a large branched stone. The removal of such a stone may cause such severe lacerations to the already damaged kidney as to necessitate nephrectomy. On this account we have sometimes advised against operation on the second kidney unless symptoms necessitating it arise. Several patients of this description have gone for years without apparent progress of the disease.

In exactly half of our cases of stones in both kidneys, the second kidney was found pyonephrotic, a condition necessitating nephrectomy.

*Stones with renal anomalies.* In three instances stones were found in a single kidney and in two instances in a horseshoe kidney. The condition was diagnosed before operation as nephrolithiasis in an anomalous kidney. In two cases in which the renal condition had not been diagnosed considerable diffi-

<sup>1</sup>Presented before the I. and M. Soc. Central District Medical Assoc. at Rock Island, Ill., Dec. 3, 1916.

culty was encountered not in removing the stone but in determining the presence of a congenital single or horseshoe kidney. When the diagnosis had been made previously the stone was readily removed from the affected portion. No complications followed in any case.

In one case of horseshoe kidney the stone had caused a pyonephrosis in the left half. This portion of the kidney was resected and recovery followed.

Renal stones were found in two patients with duplication of the renal pelvis. In both the caudal pelvis was involved in one a pelvolithotomy sufficed but in the other a resection of the upper half of the kidney was necessary.

*Stones in the remaining kidney after nephrectomy.* Stone formation or reformation in the remaining kidney after nephrectomy is an uncommon occurrence. In our series there were only two known instances. I have been greatly impressed with the fact that some persons can maintain not only life but working power with what amounts to not more than half a normal kidney. The following is an example.

Case 44000 male traveling salesman age 44 years had had stones removed from the right kidney. After a nephrectomy of the left kidney for pyonephrosis four years before was admitted to the hospital April 1900. The stone in the remaining kidney. The patient was uremic and had edema of the lower extremities. The function of the kidney was so greatly impaired and the condition so serious that an operation was advised. However the patient and his family realized the situation and urged that if possible be removed. It was accordingly found a large soft stone being removed from a badly damaged kidney. The man made such a good recovery that he was able to go back to work. The infection cleared up and returned with recurrence of infection and uremia. He then operated on by Charles H. Mayo again made good recovery and was able to resume his work. Three years later he returned in a similar condition and although extremely uremic rallied from the operation. He returned to his occupation.

*Recurrence.* Multiple stones in the parenchyma of the kidney are prone to recur. In one case in which I removed 8 stones from one kidney and 26 from the other I reoperated on the patient within two years for stones in both kidneys. Grave symptoms gradually

developed each time the stones reformed. It is possible that in the few cases of this type which have come under our observation the stone formations were secondary to hematogenous infections of the cortex. Fortunately multiple parenchymatous stones in both kidneys occur but rarely according to Braasch they were found in but 5 of 48 cases of bilateral stones.

Persons having large and branched stones located in a hopelessly damaged and infected kidney are exceedingly liable to recurrence of stone following a conservative operation and therefore if the remaining kidney is sound there is an increasing tendency on the part of surgeons to remove the affected organ at the primary operation. Previous to the nephrectomy urologic examination will have demonstrated the absence or the great reduction in functional capacity of the affected organ and will have shown that it is infected beyond permanent restoration to even limited function. In our experience one of the most common causes of recurrence of stone has been attempts to conserve a badly damaged kidney which was of little use functionally and a continuous menace to the future health of the patient.

If both kidneys are involved extensively it will of course be necessary to save them both. After the removal of the stones under these circumstances the pelvis of the kidney should be drained by a rubber tube through the cortex and each calyx containing a stone which has extended out into the parenchyma by atrophy necrosis until it can be felt with the finger as a softened ureter in the cortex should also be drained separately through a counter puncture. Drainage provides an opportunity for the relief of the infection and also for contraction of the large renal cavities from which the stones were removed. Drainage must be thorough and effected by means of a rubber tube and rubber tissue rather than gauze. Gause drainage tends to leave a fistula which is slow to heal. Small cigarette drains however are satisfactory for the drainage of the calyces and smaller stone containing pockets but a tube should be used for drainage of the pelvis.

Recurrence of stone is sometimes due also

to attempts to remove the stone through a too small incision. In these attempts the stone is crushed or fragments are loosened from it which remain in the urinary tract to be painfully passed out later by way of the ureter or to become the nidus of a secondary kidney stone.

Another error to which Brunsch has called attention is the fact that in cases of multiple stones roentgenograms may show only a single shadow because the several stones are superimposed upon each other. We therefore should not trust entirely to the roentgenogram as to the number of stones present. We must produce all the stones that are shown by the roentgenogram and then introduce the finger into the pelvis and cavities to see that no others remain. On one occasion after a stone corresponding in location, size and general appearance to the finding in the roentgenogram was removed from the pelvis a second roentgenogram made before the patient was discharged from the Clinic showed a small stone which had remained hidden. To prevent these failures a roentgenogram of the kidney is now made in every case of operation for the removal of stone before the patient is discharged from the Clinic. It has been stated that we cannot know whether or not stones have reformed in a kidney unless a roentgenogram has been taken. Unfortunately however unless a roentgenogram is taken immediately after the operation we have no means of knowing whether stone shadows in a subsequent roentgenogram are those of stones that were overlooked or of new stones.

Our experience shows that the percentage of recurrence of stone will be small certainly under 10 per cent if at the primary operation good judgment is exercised in selecting and carrying out the best surgical procedure for each individual case.

#### SURGICAL TREATMENT

Hospital organization and operating room technique have been so standardized that during an operation sepsis is rarely introduced from without. With good exposure the surgeon is able to properly handle septic renal conditions and prevent soiling of the

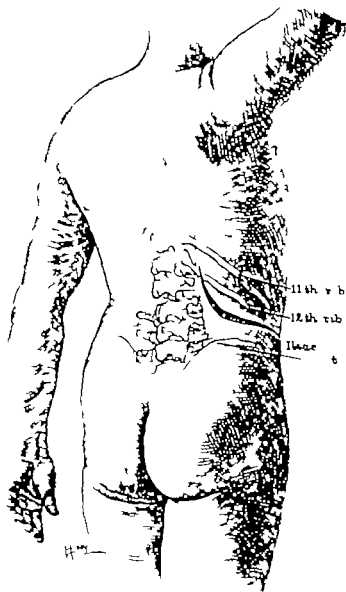


Fig. 1. Proper incision for operations on the kidney.

operative field from within. Next to soiling from septic contents of the kidney itself, lack of proper hemostasis is the most frequent cause of those processes which directly or indirectly lead to sepsis and death or those secondary conditions which end in recurrence of stone, hernia or other sequelae.

The incision outlined in Fig. 1 and which I have described previously mobilizes the lower wall of the thorax, enables adequate exposure of the kidney and does not result in injury to important nerves or other structures. As pointed out by Charles H. Mayo more than fifteen years ago, a cross cut of muscle when properly sutured is almost never followed by hernia. On the contrary, the muscle fibers have little cohesion and are



operation. The hemorrhage may be so severe as to necessitate the removal of the kidney to check it. Several of our patients had hemorrhages after operation and in 4 it was necessary to do nephrectomy to save their lives. This of course is an extremely high percentage and does not represent what might be called the normal incidence of secondary hemorrhage since the stones were removed from the kidney through the cortex not as an operation of choice but only for good and sufficient reasons. It was done for instance in secondary operations when the kidney was firmly fixed as a result of former operation.

The rule is that if a stone is removed from an infected kidney by nephrolithotomy a drain is introduced through the cut cortex of the kidney into the pelvis otherwise drainage is unnecessary. If a number of stones are present and there is atrophy necrosis in various areas of the kidney substance over the stones it is wise to drain each cavity separately. Small cigarette drains are excellent for the purpose.

*Nephrectomy 204 cases.* In not a single instance in which nephrectomy was performed was there reason to regret the removal of the kidney either after examining the specimen or in the later events of the patient's history while in a number of instances in which a conservative operation had been performed the necessity for secondary nephrectomy after some months or years of trouble made it evident that the excision of the kidney would have been the better primary operation.

In the larger number of cases in which nephrectomy was done there was pyonephrosis and stone and nephrectomy was obviously the only treatment that could be considered. Four nephrectomies were performed following conservative operations for stone. In the small number remaining in which nephrectomy was done the function was so limited as to be negligible but it would have been possible to save the remnant of the kidney. Should this have been done? Since stone did not form or reform in the remaining kidney in any of these cases and no symptoms developed subsequently to indicate renal insufficiency we must conclude that the prac-

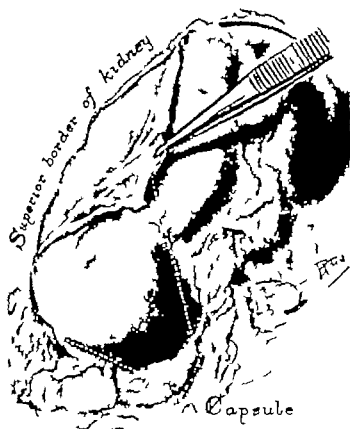


Fig. 3 Subcapsular nephrectomy. Capsule incised along the superior border of the kidney and excision begun.

tice followed was sound. In most cases nephrectomy is easily done through the incision described but in some cases especially of pyonephrosis the kidney may be encapsulated by a massive wall of connective tissue and the attempt to remove it with the protective wall may cause the accidental opening of the pleura or more often of the peritoneal cavity. While neither of these accidents are of great moment (and I have never seen trouble follow if the pleural or peritoneal rents were promptly sutured with catgut) it is at least unnecessary. The most serious risk in the removal of such a kidney with its capsule lies in the fact that on the right side the vena cava or the duodenum may be injured during the operation.

In 1900 Dr A. J. Ochsner and I saw Tuffier do a subcapsular nephrectomy. The opportunity to see this operation was alone worth the trip to France. In this country the mortality for nephrectomy in such conditions up to that time had not been far from 25 per cent. After exposing the kidney Tuffier

made an opening through the fibrous capsule down to the pyonephrotic sac and with the hand quickly decorticated the kidney. He then lifted it out from within the attached capsule which turned back about the pedicle (Fig. 3) placed a pair of clamps across the pedicle cut the kidney away and packed the cavity with gauze. On my return I described this method and I believe that subsequently subcapsular nephrectomy with the forceps treatment of the pedicle lowered the mortality of nephrectomy for pyonephrosis in America very materially. But the forceps method was clumsy and painful. It was possible of course by the use of catgut on a needle to tie off the pedicle in sections and so avoid using the clamps but if there had been soiling of the field there was danger that the needle and catgut passing through the pedicle might infect the vein. One patient in our series died from general septicæmia which I believe had this origin.

In May 1914 while on a visit to Petrograd I saw that master surgeon Federoff make in addition to subcapsular nephrectomy which rendered the securing of the pedicle extremely easy. Drawing the kidney out of its capsule with a knife he separated the capsule from the sinus of the kidney and it was folded back over the pedicle. This allowed the kidney with the renal vessels to be drawn through the capsule top and bottom and made possible separate ligation of the vessels (Fig. 4 frontispiece).

The most difficult nephrectomies are those which must be done following a nephrotomy which has left a fistula leading to a remnant of kidney. The safe way is to introduce a knife through the fistula to the kidney and then split all the outer wall until a sufficient opening has been made for subcapsular nephrectomy (Fig. 5). If forceps are left on the pedicle the admonition of Price should be remembered. Unclamp the forceps at the proper time 48 to 72 hours but do not remove them until from 8 to 12 hours after ward in order that the tissues firmly compressed may have an opportunity to retract. Should the forceps be removed at once after unclamping the ends of the vessels in their bite may be torn apart permitting hemor-

rhage. In case there is a drainage tube in a fistula leading to a calcareous pyonephrosis previously operated on the drain should be removed several days before the nephrectomy to reduce the local irritative infection.

#### COMPLICATIONS AND ACCIDENTS

*Exploration.* In a small percentage of cases requiring operation it is impossible for the urologist to determine the exact condition of each kidney by means of cystoscopic data or functional tests. In such cases therefore exploration of each kidney becomes necessary. In this exploration three methods may be employed (1) examination of the presumably sound kidney before operating on the kidney known to be affected (2) exposing the affected kidney and judging from its condition the probable functional capacity of the remaining kidney and (3) opening the peritoneal angle of the incision described and exploring the second kidney with the hand intraperitoneally. The latter method is not of great value unless the kidney to be examined is grossly affected.

Intraperitoneal complication can be readily detected through the peritoneal incision. Exploration of the gall bladder appendix spleen pelvis etc. can be easily done and may yield information of great value.

*Oleity.* In very fleshy persons or occasionally those with crippling deformities such as hip ankylosis it may not be possible with safety to bring the kidney sufficiently into the wound to remove the stone. Sometimes fracture of the twelfth rib just behind the angle will give sufficient space. In other instances I have removed enough perirenal fat to expose the kidney *in situ* much as one would expose the uterus within the peritoneal cavity.

*Hæmorrhage.* In performing an operation on the kidney large renal veins are occasionally injured flooding the field with venous blood. I have checked this hæmorrhage by using catgut on a small needle and there has never been anything about the convalescence of the patient or the function of the kidney later to show that harm resulted. Injuries of the vena cava can be controlled in the same manner. Occasionally however renal

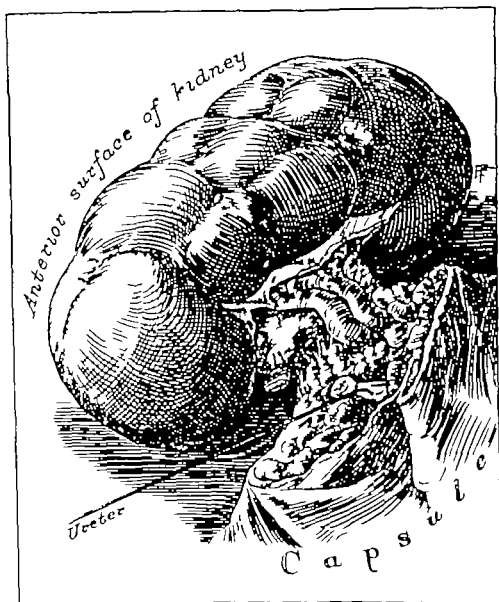


Fig 5. Subcapsular nephrectomy for pyonephrosis. Ureter tied and divided. Kidney drawn away from the capsule exposing the renal vessels.

arteries of considerable size have been injured. In one such instance there was a secondary hemorrhage and it was necessary to take the kidney out at the end of twelve days. I was astonished to see that the injury and ligation of this large branch of the renal artery had resulted in acute degeneration of almost the entire kidney. This is what we might expect from animal experimentation and would indicate that while conservation should be practiced when veins are injured primary nephrectomy may be better when there is injury to large arteries.

*Laceration of the pelvis of the kidney.* In the attempt to explore the interior of the pelvis and calyx of the kidney with the finger the

pelvis of the kidney may be considerably lacerated but in our experience if it is sutured with catgut and a fatty fascial flap is carefully applied about it primary healing has always taken place. This is equally true in those cases in which the pelvis is badly lacerated in the removal of large stones. In a most difficult pelvicolithotomy I once completely detached the pelvis from the kidney. It was reattached with fine catgut sutures which in some situations at least did not bring the separated fragment of the pelvis directly in contact with the part from which it had been torn. The suture line was covered with a fatty fascial flap and good union and function resulted.



*Injuries to the duodenum* I have already described elsewhere injuries to the retroperitoneal duodenum. Such injury occurs on the right side and usually is the result of the use of rat toothed forceps in a hasty attempt to check hemorrhage from the pedicle of a kidney which has slipped. Rat toothed forceps should never be used hastily in the control of hemorrhage in a situation where important organs may be injured especially since it is so easy to control the hemorrhage by catching the vessel with the thumb and fingers. The artery furly jumps into the fingers as the stream of blood lead the way to it and a pair of mouse toothed forceps can then be applied for temporary control. When injury to the duodenum does occur the accident will show

at the end of a few days a necrosis permits escape of the duodenal contents. The patient thus injured will die within three weeks unless the abdomen is opened interiorly the retroperitoneal part of the duodenum exposed and the fistula sutured.

#### IDENTICALS

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## CLINICAL DATA OF NEPHROLITHIASIS

By WILLIAM I. BLANCHARD, M.D., ROCHESTER, MINNESOTA

FROM January 1, 1898 to January 1, 1916 450 patients were operated on at the Mayo Clinic for nephrolithiasis.

The total number of operations including those for recurrence and bilateral stone was 484. A review of the clinical records both pre-operative and post-operative gives data of considerable interest.

*Identification of kidneys in the roentgenogram.* It was not long ago that surgical explorations were made for renal stone because of a history of pain referred to the region of the kidney. Today the surgeon would rarely make such an exploration without previous X-ray examination. However although we depend on the X-ray for our diagnosis of renal stone an increasing reaction has developed against its infallibility in recent years. It has frequently happened that the roentgenogram has shown a shadow which appeared to be stone but at operation no stone was found. It has also happened that no shadow has appeared in the roentgenogram and at operation even large stones were found. It is now well recognized that the roentgenogram

may lead to considerable diagnostic error unless its interpretation is aided by cystoscopic and allied data. The mistakes are principally of two types: (1) error in interpretation and (2) failure to show the stone shadow. Error in interpretation has been largely eliminated through the aid derived from the cystoscope and particularly from pyelography. Failure on the part of the X-ray to show a shadow still persists in a small percentage of cases but it is usually the result of error in roentgenographic technique. Interpretation of the roentgenogram without complete clinical and cystoscopic data is inaccurate and operation based on such evidence alone is not good surgery.

*Localization of stone.* The localization of the stone is of as much importance in the diagnosis as the identification. It is obvious that if exact localization is made prior to operation the removal of the stone is facilitated: first by guiding the operator in his search and second by suggesting the most feasible method of procedure. When the shadow is large (an inch or more in diameter) the surgeon does

not as a rule have much difficulty in finding the stone when however it is smaller considerable difficulty may arise in finding the stone in the kidney which usually becomes congested and enlarged when brought to the surface. The exact situation of a stone in the kidney is often difficult to determine in the original roentgenogram. By outlining the renal pelvis in a pyelogram and then comparing it with the position of the stone shadow the stone can be localized more accurately than in the ordinary roentgenogram. The main problem in the localization of the stone is to determine whether it is situated in the true pelvis in a calyx or in the cortex. If situated in the pelvis the shadow may be obscured by the pelvic outline and the exact position can be determined only by comparing the pyelogram with the original roentgenogram. Frequently however the outline of the stone is visible through that of the pelvis. When the stone is situated in a calyx its outline may be seen through that of the calyx which is usually characterized by definite deformity. When the stone is in a calyx, the comparative size of the calyx may be ascertained and this may be of value in determining the possibility of removing the stone through the pelvis. When the stone is situated partially in a calyx and partially in the cortex, its outline may be seen extending beyond that of the calyx. When situated in the cortex the stone may be seen clear of the pelvic outline.<sup>1</sup>

It is also true however that when the stone is very small say less than one centimeter in diameter the question may well arise whether it should be considered as surgical. Since when in the pelvis or calyces a large proportion of such small stones are passed spontaneously it is usually better to postpone operation unless the symptoms become severe or some complication arises. Even when the stone has been localized in the cortex it is often advisable in the absence of marked symptoms to await a moderate degree of increase in its size. The mutilation of the kidney substance in the search for a very small stone may cause considerable permanent destruction of the tissue.

*Situation of the stone* A review of the cases in which operation was performed shows that the situation of the stones, other than those found on nephrectomy, was as follows: 180 in the pelvis, 14 in the pelvis and calyces, 12 in the pelvis and cortex, 20 in the calyces, 48 in the cortex, and 8 at the ureteropelvic juncture. Since stones found in the calyces and at the ureteropelvic juncture are in portions of the pelvis we have a total of 222 cases (78 per cent) with pelvic stone. The number of cortical stones was 60 (21 per cent). Exact localization of the stones was impossible in many of the cases of nephrectomy because of the wide spread destruction of tissue but as far as could be ascertained the number of stones situated in the pelvis and cortex was about equal.

*Multiple stones* Renal stone was found to be single in 285 operations and multiple in 188. The large proportion of the multiple stones may be explained in a measure by the fact that with most of the patients of this group the symptoms were of long duration. The several stones usually form at different intervals over a period of years and it is evident that this process together with destruction of the kidney could be largely prevented by early operation. Multiple stones occurred in 124 cases of pyonephrosis requiring nephrectomy and the consequent renal destruction prevented exact localization. In many cases of this group in which the stones were localized in the cortex they evidently occurred secondarily to larger pelvic stones. The location of the multiple stones in the other operations was as follows: pelvis 24, calyx 6, cortex 16, pelvis and calyx 10, pelvis and cortex 8. From this it may be inferred that where multiple stones are found there is such destruction of kidney tissue that nephrectomy will be necessary in more than 60 per cent.

It may be inferred also that multiple stones when primary occur more frequently in the pelvis and calyces than in the cortex. In many cases in which multiple stones were found at operation only a single shadow was present in the roentgenogram previously made; in others there was one definite shadow together with one or more other shadows.

which could not be definitely interpreted as due to stone. In many instances it was necessary to make a very careful search of the entire kidney in order to find the various stones. Therefore we should not always be content with the roentgenographic evidence as to the number of stones present and the surgeon should make a careful search for more than one stone even though the roentgenogram may show only a single shadow. It is probable that in many cases reported as recurrence of renal stone one or more stones were not found at the time of the first operation and the remaining stones were regarded as recurrences.

*Coincidence of stones in the kidney and ureter.* A stone was found in the ureter and the kidney on the same side in 6 patients (5.7 per cent). This is of interest as it indicates the necessity of plates showing both the kidney and the entire ureter. When there is a definite stone shadow in the area of the kidney a small shadow in the ureter may be easily overlooked. The data derived from the cystoscopic examination, ureteral catheter and pyeloureterogram are frequently necessary to identify a shadow of this kind. The question frequently arises as to the best method of surgical procedure in this complication. Whether or not the stone in the ureter should be removed first depends largely on the degree of function in the affected kidney. If on cystoscopic examination it is found advisable to save the kidney it is usually well to remove the ureteral stone first. When the function of the kidney is largely destroyed nephrectomy is indicated as the primary procedure. When a large irregular stone remains in the ureter it is advisable to remove it at a secondary operation. When the stone is small however and the ureter is not extensively dilated it may not be necessary to remove the stone at all. When there is considerable dilatation of the ureter due to the stone it may be advisable to perform a ureteronephrectomy. As a rule no urinary leakage from the bladder by way of the remaining ureter will develop even though the ureter is greatly dilated. We have observed two cases however in which this has occurred and necessitated subsequent ureterectomy.

Also occasionally when a thick dilated and infected ureter is left a fistula discharging a small amount of thick pus may persist and necessitate subsequent ureterectomy.

*Branched stone.* Seventy-six stones were described as being distinctly branched. Counting only operations other than nephrectomy where exact localization was not possible the stone was found in the pelvis and calyces in 22 cases and in the substance of the kidney in 14. It is evident therefore that branched stones are found more frequently in the pelvis and calyces than in the cortex. As a rule branched stones found in the pelvis are much larger than those in the cortex and follow the outline of the various calyces. Even though a branched stone almost fills the pelvis it may cause few symptoms since it may not alter its position so as to interfere with the urinary excretion. The branched stone is frequently soft, casts a very dim shadow in the roentgenogram and at operation often crumbles into a sand like substance. Not infrequently what appears to be a single branched stone in the roentgenogram proves at operation to be made up of numerous smaller parts which are so grouped as to give the appearance of a single branched stone. The amount of renal secretion remaining with a large branched stone is frequently amazing. There may be but little gross evidence of renal lesions in the urine and but a few microscopic pus cells or red blood cells. The various operations found necessary were as follows: nephrectomy 40 cases (52 per cent), pyelolithotomy 16 cases (21 per cent), nephrolithotomy 14 cases (19 per cent) and combined nephrolithotomy and pyelolithotomy 6 cases (8 per cent).

*Bilateral stone.* Bilateral occurrence of stone was noted in 48 patients — 9.9 per cent of the total number operated on. This however does not represent the entire number of cases of bilateral stones examined at the Mayo Clinic. Up to 1916 the clinical records show that 24 patients with bilateral nephrolithiasis were examined but not operated on. A large proportion of this number were regarded as better off without operation because of the absence of subjective symptoms or the large size of the stones. A smaller

number was found to be inoperable because of the advanced destruction of the kidney or secondary infection. The symptoms were not regarded as being sufficiently severe to require operation. If we were to include all cases in which the diagnosis was evident but in which no operation was performed the percentage of bilateral occurrence would be higher. At operation the stones were found situated as follows: In the cortex on both sides in 10 cases; in the cortex on one side and in the pelvis on the other in 14 cases; in the pelvis on both sides in 10 cases (in the kidney on one side and in the ureter on the other 3 cases); and in the pelvis on one side associated with pyonephrosis on the other in 14 cases.

*Previous operations.* One hundred and forty three patients or practically one third of the total number had had previous laparotomies performed elsewhere for relief of pain. Of this number 83 had stone in the right kidney, 55 stone in the left kidney and 5 bilateral stone. It is evident that laparotomy was performed more often for stone in the right kidney than for stone in the left. It is of interest that 21 of the patients with stone in the left kidney had had previous operations on the appendix or gall bladder.

Previous operations on the kidney done elsewhere were recorded in 23 cases. The operations were nephrectomy, partial or complete, 13 cases; nephrotomy, 7 cases; pelviolithotomy, 3 cases. At the time of the secondary operation the kidney was found to be so largely destroyed in 14 cases as to indicate nephrectomy. After previous operation done elsewhere a fistula persisted in 12 patients and in every case nephrectomy was found necessary. A fistula persisted in 3 patients following operation at the Mayo Clinic.

*Passed stone.* Fifty three of the patients gave a definite history and 14 a somewhat questionable history of having passed a stone from the kidney prior to the operation. Eight described the pain at the time of passing the stone as being on the side opposite the kidney operated on. Seven patients evidently had passed stones from both kidneys. In the majority of cases the stone was probably passed from the same side as that oper-

ated on. Single stones were passed in 23 cases and more than one stone in 30 cases which indicates that the passage of multiple stones is more frequent and is suggestive of a stone forming tendency in the kidney.

At operation of those who had passed multiple stones (30) a single stone was found in 15 patients and multiple stones in 15. Of those who had passed single stones (23) single stones were found at operation in 16 and multiple stones in 7. From this it may be inferred that when multiple stones have been passed the chances for finding multiple stones at operation is greater than when single stones have been passed. As to the type of operation in this group a nephrectomy was found necessary in 18 cases, nephrolithotomy in 18 cases and pelviolithotomy in 16 cases.

*Type of operation.* The operations performed were divided as follows: nephrectomy in 188 cases, nephroureterectomy in 16, pelviolithotomy in 206, nephrolithotomy in 40, combined pelviolithotomy and nephrolithotomy in 34. The large proportion of cases in which nephrectomy was found necessary, 0.4 (41 per cent) is of interest. Most of the cases in this group were diagnosed clinically as pyonephrosis and stone. In the other cases the amount of healthy tissue remaining was so little that nephrectomy was clearly indicated. The stone was described as multiple in 124 cases (66.7 per cent) and single in 64 cases (33.5 per cent). With single stones the pyonephrosis as a rule is secondary to the stone formation. With multiple stone the stones are frequently formed secondarily to the inflammatory process. In many of these cases the duration of symptoms extended over a period of many years and the condition was either unrecognized or had remained dormant. Although the kidney was saved whenever it was possible, nephrectomy was usually deemed advisable in the presence of wide spread destruction of the kidney tissue.

That pelviolithotomy is the operation of choice when possible is demonstrated by the comparatively large number of patients on whom it was done. In some instances although the stone was situated in the pelvis or calyces either nephrotomy alone or com-

lined with pelviotomy was preferable because of areas of tissue necrosis in the cortex requiring drainage. Removal of the ureter as well as the kidney was found necessary in 16 cases. In the majority of these there were one or more stones in the ureter with consequent marked dilatation and infection. It was feared that the dilated ureter might act as a diverticulum with secondary formation of stones or that it would become a focus of urinary infection. It is rare however that in ureter even though markedly dilated permits permanent reflux of urine from the bladder unless there is some malignant complication.

Perinephritic abscess was found in 10 cases. In 3 it was so extensive that preliminary drainage was first effected. In the others however nephrolithotomy or nephrectomy was done at the same time usually the preferable procedure. This number does not include perinephritic involvements such as fibrous adhesions or large deposits of inflammatory fat which are frequently found.

**Mortality.** As nearly as could be ascertained the total number of patients who have died since the operation is 35. Of this number 3 died in the hospital because of the operation — an operative mortality of 0.6 per cent. It is of interest that no chemical estimate was made of the function of the remaining kidney, surgical judgment having been based on the grosser clinical findings together with careful cystoscopic and roentgenographic examination. The 3 deaths that occurred in the hospital followed nephrectomy for pyonephrosis and multiple stones. The symptoms were of long standing and the patients were weakened and toxic as a result of the chronic infection. One died from septic pneumonia three weeks after operation, the second (an emergency case) from evident renal insufficiency and the third died two weeks after operation with evidence of sepsis. It will be noted that there was no operative mortality following either nephrolithotomy or pelvic lithotomy.

On reviewing the histories of the 32 patients who died subsequent to recovery from operation it was found that 8 had bilateral nephrolithiasis. It is evident that the prognosis of

bilateral stones is much more unfavorable than that of unilateral stones. In most of the 8 cases death occurred within one or two years after operation.

There were 22 deaths following nephrectomy for pyonephrosis and stones. Practically all of the patients had had symptoms of long standing prior to operation and on clinical examination showed effects of the chronic infection in other organs which evidently was the chief factor in shortening their lives.

As far as could be ascertained the cause of death of the 32 patients was renal complications in 12 cases and other causes in 7. In 13 instances the exact cause is not known but was evidently not renal. Besides the 3 patients who died immediately following the operation 14 died within one year after 5 from 2 to 3 years after and 7 more than 3 years after. In 6 instances the date of death is not known. The after course of patients subsequent to the operation was as follows: 43 were reported alive and well more than 10 years after operation, 121 more than 5 years after and 110 more than 2 years after. The bulk of the operations however occurred within the last 5 years. The larger percentages of the subsequent deaths were due to renal complications either bilateral nephrolithiasis, nephritis or infection in the remaining kidney. The majority of patients is shown died during the first year following operation.

**Postoperative results.** The frequency of the recurrence of renal stone has long been a disputed subject. Of considerable interest are the figures recently published by Cabot who claims that among 66 patients previously operated on for renal stone at the Massachusetts General Hospital and who were recently re-examined recurrence of stone was found to be 49 per cent. Because of the wide geographical distribution of the patients operated on at the Mayo Clinic it is impossible to make a re-examination in every case. However complete clinical data including X-ray urinalysis etc. were obtained for 88 patients previously operated on for renal stone who returned to the Clinic for re-examination. Of these 88 patients 13 (14.7 per cent) had re-

currence. This percentage of recurrences however is manifestly higher than that in all patients operated on since nearly all of those re examined had sufficiently definite symptoms to cause their return.

In a large number of cases (75) the findings on re examination were negative although many of the patients had definite aches and pains referred to either the renal area or the upper abdomen. From this it is very evident that positive subjective symptoms are not to be relied on. Occasional pain referred to the kidney area following a renal operation is not uncommon and may be explained either by functional causes or possibly a remaining renal infection injury to a nerve etc. Among the 75 negative cases the roentgenogram showed a shadow either in the kidney or ureter in 5 patients. These shadows however were definitely proved to be extra renal and extra ureteral either by means of careful cystoscopic and pyelographic examination or surgical exploration. It is evident therefore that the presence of roentgenographic shadows alone in the kidney can not always be regarded as absolute evidence of the recurrence of stone.

The urine of 8 of 69 patients found negative on roentgenographic examination showed red blood cells and pus cells usually but few in number. This indicates that a mild degree of infection frequently persists for a long period after the removal of the stone and the question may well arise whether such infection is not the original etiologic factor. In the 13 positive cases urinalysis showed the presence of red blood cells or pus cells to a variable degree in every case.

Of the 13 patients in whom a recurrence was found 11 were reoperated on. In every case but one the stones recurred in the same portion of the kidney as at the primary operation. In 2 instances the stone had been removed from the pelvis. In 1 it had been found in the cortex in the primary operation and the subsequent operation disclosed multiple recurrence with such destruction of the kidney that nephrectomy was necessary. Repeated recurrence requiring a third operation was noted with 2 patients only the others remaining well after the second operation. In

but 2 cases in which a nephrectomy had been done was recurrence noted in the opposite kidney. In another case a small stone was passed from the opposite kidney shortly after the operation and it may be assumed that it was present but undiscovered at the time of operation. As Cabot has suggested the rarity of the appearance of stone in the opposite kidney subsequent to nephrectomy must be regarded as indicating renal lithiasis to be dependent on anatomical factors. That bilateral stones have no particular tendency to recur is evident from the small number of recurrences noted in 5 cases (11.9 per cent).

In order to obtain information concerning the subsequent course of patients operated on for renal lithiasis and not re examined letters of inquiry were sent out asking detailed questions as to exact location and severity and time of any recurring attacks of pain. Two hundred and eighty seven replies were received. From these it was inferred that 241 patients should be regarded as negative 15 had probable recurrence and 18 had passed stone some time following the operation.

Although judging from a review of the symptoms of the 450 patients operated on absence of well marked pain does not necessarily exclude the possibility of recurrence of stone this group constitutes a very small proportion of the total. In order to further study a few patients with doubtful symptoms specimens of their urine were obtained for examination. With but few exceptions these were negative.

Fifteen patients had symptoms sufficiently positive to make it probable that they had had recurrence although we were unable to corroborate this by X ray and cystoscopic examinations. With one exception specimens of urine contained pus cells and blood cells. It is of course probable that several of this group would show no recurrence on direct examination. This number would offset the possibility of error in the negative group.

Eighteen patients claimed to have passed stones following operation. In 4 cases however the pain was on the side opposite to that operated on. One patient had had a nephrectomy so that the recurrence must have been





Fig. 1 Case 1 Mrs. B. General circinmato. Roentgenogram of chest made February 6, 1914, showing destruction of at least three inches of the left second rib due to metastatic carcinoma. See arrow.



Fig. 2 Same case as Fig. 1. Roentgenogram made two years later February 3, 1916, showing complete recalcification and healing of this rib. Other diseased bones were also found healed.

patients can often be induced to submit to electrothermic coagulation or electrical desiccation and equally good or superior results can be obtained.

Another common cause of neglect of early malignant lesions or precancerous conditions is the soothing and comforting words of the family physician. I believe that the truth plainly told would accomplish better results for I am sure more people die from neglect than from fright.

The means at our command that have been proved of definite value in the elimination of malignant disease from the individual patient consist in its aseptic removal by surgery, electrothermic coagulation, deep roentgentherapy and radium. I believe that the intelligent combination of two or more of these methods will accomplish far more than any single method. Therefore while I recognize the great and indispensable value of surgery in the treatment of malignant disease I will confine my remarks to deep roentgen therapy and electrothermic coagulation which are two methods that are not sufficiently well known and that have been proved of great value.

The term deep roentgentherapy has been coined since the technique of crossfiring and filtration has been more perfectly developed and the advent of the Coolidge tube which makes possible the use of a tremendous quantity of deeply penetrating rays which will permit of much filtration of the rays and yet not overtax the patient's energy or the time and patience of the operator in

administering the necessary quantity. It implies what is now known to be a fact that deep seated malignant disease can be influenced by means of the roentgen rays.

#### THEORY OF THE EFFECTS OF THE ROENTGEN RAYS ON MALIGNANT DISEASE

The results obtained in the treatment of malignant disease depend primarily upon the exceeding sensitiveness of pathologic cells to the roentgen rays for it is well known to all who have had experience with epithelioma as an example that with the same dose of rays given to the epithelioma and the surrounding tissue the epithelioma undergoes degeneration and seems to melt away while the surrounding healthy tissues may show no effect or no more than a little redness. It has been shown too by histologic studies made on tissues which have been subjected to the effect of the rays that these cells undergo degeneration before any effect is shown on the healthy cells. It is also well known that the more nearly cells approach the embryonal type the more sensitive they are to the rays and among normal tissues the essential cells of glands are more sensitive than the stroma and next to the glandular cells come the protective epithelium such as the skin, mucous membrane and intima of the blood vessels, and next to this the connective tissue cells.

Some very interesting and instructive studies of the microscopical changes taking place in the tissues of animals and human beings have been reviewed and recorded by





subject. They state that before the ultimate disappearance of the growth the cells pass through at least five successive phases which are characterized as follows:

1. The latent phase
2. Development of monstrous characters
3. Keratinization
4. Disintegration and phagocytosis
5. Formation of the connective tissue scar

Their illustrations are most convincing of the effects of the rays on tumor cells. When sarcomatous cells are exposed to X rays the same authors found that a somewhat similar transition in the cellular characteristics occurs but the latent phase during which no changes are observable is very much shorter than in the other types of malignant growth considered. Instead of being from 6 to 10 days it is generally 1 or 2 days.

Nogier and Regnaud<sup>1</sup> have submitted evidence based upon a clinical experience of more than one hundred cases of malignant growths that there often occurs a gradual diminution in the sensitiveness of these growths to X rays. The clinical indication is that when a growth is exposed for the first time to X rays a marked diminution in its size may occur but when the rays are again applied after an interval of some days or weeks the same dose of X rays does not now appear to be so effective and succeeding applications of the rays may have no apparent effect upon the growth. The remaining cells of the neoplasm appear to have become more resistant to the rays. This observation by Nogier and Regnaud agrees with my own observations and I am sure that it agrees with that of all other men who have had a wide experience and is of considerable importance from a radiotherapeutic point of view for it should decide to some extent the method by which radiation is best administered to growths which exhibit this phenomenon. I believe that it teaches the lesson that the largest dose possible should be given to a tumor from as many angles as possible in a single course of treatment so that this resistance to the rays will not have time to be developed by the cells.

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Fig. 4. Same case as Fig. 1, 2 and 3. Roentgenogram made a year later, June 29, 1916, almost three years after beginning treatment, showing marked calcification and probably healing of the sacrum and iliac bones.

#### TECHNIQUE IN ROENTGENOLOGY

I will have to be brief in the discussion of technique but will refer those who are interested for other details to my previous papers upon the treatment of malignant disease. Great improvements have been made in the technique of deep roentgen therapy within the past few years. These improvements consist *first* in the development of more powerful apparatus which will give rise to more penetrating rays. This involves primarily the Coolidge tube but secondarily an apparatus which is capable of giving an output of a large quantity of current but more particularly a current with a high degree of voltage. This development has permitted the *second* which is equally important consisting of extensive filtration of the rays which will reduce proportionately the rays affecting the skin. The *third* great improvement consists in the development of more extensive cross-firing. The improvement in apparatus is usually discussed thoroughly by manufacturers and from a commercial standpoint. Therefore I shall

See reference at end of article

confine my remarks to the improvements in filtration and crosshiring.

**Filtration.** My first experimental work upon animals and clinical work in the use of filter was done in 1903, based upon the ground principles developed by Walters. At first I made use of a leather filter consisting of a thickness of sole leather for the purpose of eliminating the rays that are more or less distinctly absorbed by the skin. The great value of filtration was proved by the animal experiments and by the subsequent clinical results but since that time the filtration has been increased to a great extent. Two or three years ago I had increased my filtration to three millimeters of aluminum and a layer of sole leather. At the present time I am using six millimeters of aluminum or its equivalent in deep work. Generally I use at present four millimeters of glass and two millimeters of aluminum. This glass filtration has the advantage of serving as an insulator (23) and being less affected by the heat. The glass used has about the same absorbing value as aluminum. It must be clearly understood that this does not prevent or eliminate the possibility of X-ray burns for one can still burn the skin seriously through any amount of filtration. It does however permit the administration of at least ten times the quantity of rays into the deeper tissues and when this filtration effect is added to the crosshiring effect we can increase our deep results perhaps one hundred times as much as we could do ten or fifteen years ago.

**Crosshiring.** In my very early work ten or fifteen years ago I used a certain amount of crosshiring in the treatment of disease especially about the breast but the real elaboration of the idea belongs to Cusa. This crosshiring requires a certain amount of engineering skill but in general the object is to have the rays cross from as many angles as possible through the deeper portions of the tumor and in crossing through the deeper portions of the tumor one is compelled to have treated all of the outer borders of the tumor and the lymphatic gland leading

therefrom. Each area of skin through which the rays are passed to reach the central portion of the tumor is spoken of as a portal of entry. The more portals of entry and the more angles from which one attacks the tumor within certain limits the deeper the effect obtained. Each portal of entry should be carefully separated from the neighboring field by means of sheets of lead carefully stripped to the skin by adhesive plaster so that there is a clear space of untreated skin of from one eighth to one fourth inch for if these areas overlap at all a burn will be produced. The more one multiplies these portals of entry the more expense is incurred and the more tiresome the treatment becomes to the patient. Therefore one should be careful to keep within practical limits so that he may obtain good therapeutic results. Many other technical points have been discussed in previous papers and therefore will not be repeated in this one.

#### DEEP ROENTGENTHERAPY COMBINED WITH OTHER METHODS

The roentgen rays have been proved of undoubted value in the treatment of malignant disease but great as this value is I believe that the greatest field of usefulness of deep roentgentherapy is in the postoperative treatment of malignant disease. This does not mean that a surgeon can cut away at random masses of malignant tissue and leave definite malignant tissue behind and then expect to control it and get the patient well by means of deep roentgentherapy. It means that when the surgeon does a clean surgical operation which he has been doing the results will be tremendously improved if he would add the deep roentgentherapy in postoperative treatment. This subject has been dealt with in more detail in an article on the Post Operative Treatment of Carcinoma of the Breast (24).

*Roentgentherapy may also be combined with electrothermic coagulation to great advantage and I believe in some instances with superior end results over the combination of surgery and roentgentherapy. It is now almost my routine procedure to combine electrothermic coagulation with deep roentgentherapy in*



Fig. 5 Case 2 General carcinomatous Roentgenogram made August 9, 1915 showing metastatic carcinoma in a number of the vertebrae and in the tenth rib on the right and the eleventh rib on the left indicated by arrows.

Fig. 6 Same case as Fig. 5 Roentgenogram showing recalcification of the tenth and the eleventh ribs and to a considerable extent of the vertebrae.

the treatment of all superficial lesions such as epitheliomata degenerating moles superficial sarcomata and in nearly all epitheliomata of the mouth. When the epitheliomata about the mouth are associated with glandular metastasis I believe that the metastatic glands should be dissected out by the surgeon and at times the blood vessels ligated. I believe however that in the majority of instances the destruction of the malignant disease within the mouth by electrothermic coagulation will give better results than will be obtained by surgical excision. In all this group of cases however I am quite sure that a conference between the roentgenologist and the surgeon will give the best end results for in each case there are certain debatable points which must be considered. The decision as to the best procedure will often depend upon the extent of the involvement, the general condition of the patient, the skill of the surgeon and the skill of the one who is to do the electrothermic coagulation.

*Roentgentherapy may also be combined with radioltherapy* but the roentgen rays and radium should never be applied through the same surface of skin or mucous membrane for we are using two agents having the same general physiological effects on the tissues

and by doubling this effect serious results may occur in the form of burns which will prevent the future proper treatment of the patient. The two agents may be combined to advantage when radium is applied within cavities directly within the tissues as has been suggested by Burnham within the open wound or within the axillary space as has been suggested by Boggs while the roentgen rays are applied externally crossfiring upon the disease. In this way one is simply adding another point of crossfiring.

*Surgery electrothermic coagulation roentgen rays and radium* may all be applied in the same case to advantage in some instances. I have in mind particularly the mouth cases such as I have described before the Dermatological Section of the American Medical Association at its annual meeting in Detroit June 15, 1916 (20). In this way I am sure that we have obtained results that have never been equalled by any single method. Cooperation should be our watchword in medicine today but especially in the treatment and control of malignant disease.

#### ELECTROTHERMIC COAGULATION

Electrothermic coagulation has been described by me previously in more detail (19 and 20). Briefly the process consists in the de



Fig. 7. Same as Fig. 5 and 6. General anesthesia. Roentgen beam made September 29, 1906. Metastatic carcinoma of the gland of the head of the humerus.



Fig. 8. Same as Fig. 5, 6 and 7. General anesthesia. June 9, 1906 showing recalcitrant and healing of the gland process and the head of the humerus.

struction of the malignant disease by coagulation produced by the heat generated in the tissues because of the resistance to the flow of the electrical current. The type of current used is the high frequency of the *Thyratron* type. When used for destruction it is synonymous with the term diathermy. It is also synonymous with the American understanding of the incorrectly used term fulguration. It is nearly the same process as electrical desiccation as described originally by Clarke except that electrical desiccation involves the use of the Oudin current. I prefer the Oudin current and the electrical desiccation method for very superficial lesions because it can be more delicately controlled and less destruction of tissue occurs. In general however there is more danger to the welfare of the patient from too little destruction than from too much for one must often sacrifice cosmetic results for permanency of result in the treatment of malignant disease.

It is a bloodless procedure the diseased area is fully destroyed and then either cut away by curved scalpel or allowed to slough away. It is very painful and must be done under either local or general anesthesia. It is especially indicated in malignant disease about the mouth such as the lip, tongue, gums, cheek, and throat though in one case I successfully removed an inoperable carcinoma of the breast which was referred to me by the late Dr. Robinson. In all my experience however I have only seen one or two cases

of carcinoma of the breast which were suitable for this treatment.

#### CLASSIFICATION OF CASES AND RESULTS OBTAINED

1. *Epithelioma of the skin*. I believe that by means of deep roentgentherapy or better the combination of deep roentgentherapy and electrothermic coagulation or electrical desiccation that practically all epitheliomata of the skin can be completely and permanently cured unless they have extended to the deeper tissues and involve the cartilage or the mucous membrane or the deeper tissues of the face such as the ethmoid cells. So too I believe that thorough surgical excision followed by roentgentherapy should produce a permanent cure in practically all cases. In treating the superficial epitheliomata it is our custom to destroy completely the malignant tissue together with a small area beyond the actual microscopical involvement by means of electrical desiccation or electrothermic coagulation and then follow immediately by a full dose of deep roentgentherapy. If the lesion is large some means of local anesthesia is usually required for the destructive purpose. The roentgen rays are of course painless and not in the least objectionable. In the great majority of instances I believe that this first destruction and roentgentherapeutic application would be sufficient to produce a permanent cure but it is my custom to treat the patient a

second time at the end of the month and then if convenient two or three times more during a year in order that I may be quite sure of a permanent and successful result. At the subsequent visit if there is the slightest doubt as to the total obliteration of the malignant disease I give another application of deep roentgentherapy.

*Epitheliomata about the mouth.* In a recent paper before the American Medical Association I described in considerable detail the Treatment of Malignant Disease About the Mouth by Combined Methods (10). In the present paper therefore I shall refer only very briefly to some of the results that may be expected.

*a Epithelioma of the lip.* Of the primary cases treated by X rays alone 87 per cent recovered and remained well for from a few months to a year. Of the primary cases of epithelioma of the lip treated by electrothermic coagulation and X rays all have recovered and remained well from six months to seven years. Of the primary cases of epithelioma of the lip treated by surgery and X rays all have recovered and all have remained well from two to thirteen years. Of the three cases with local recurrences following excision treated by the roentgen rays all have recovered. One has since died from intercurrent disease but had remained well several years. One other is well two years and a third had in addition to the local recurrence a small metastatic nodule in the submental region. This disappeared under X ray treatment and he has remained well seven years since. There were 10 recurrent cases treated by X ray and electrothermic coagulation. They have remained well approximately a year each.

*b Epithelioma of the tongue.* First those involving the dorsum of the tongue. In this group there have been six cases. One patient who had also metastatic involvement did not recover. Four patients have recovered and have remained well from one to four years. The sixth patient has been under treatment three months. The posterior two-thirds of the left side of the tongue was involved ulceration had taken place. He was treated with radium placed in the fissure of the tongue and deep roentgentherapy



Fig. 9 (at left) Same case as Figs. 6 and 8. Roentgenogram made March 14, 1916 showing both the reparative and destructive processes going on in hand but especially marked destruction in the eighth ninth and tenth vertebrae due to metastatic carcinoma.

Fig. 10 Same case as Figs. 5, 6, 8 and 9. Roentgenogram made June 10, 1916 showing considerable recalcification of these vertebrae indicated by the sclerosis and increased density.

applied both inside the mouth and externally. This has shown marked improvement even at the end of a month and at the end of two months the ulcer had practically healed. There was some slight necrosis of the mucous membrane due to the action of the radium this necrosis being shown both on the cheek and on the side of the tongue. I am hoping that he will recover.

*c Epithelioma under the tongue and involving the floor of the mouth.* In this group there have been seven cases. All showed extensive disease. All were destroyed by electrothermic coagulation locally followed by deep roentgentherapy. All healed primarily. Five developed recurrences and three have died. There are still four under treatment. Two are free from recurrences. The seventh case in which the epithelioma involved two inches of the side of the tongue including the floor of the mouth in an old man of 71



Fig. 1. Case 1. Roentgenogram made February 20, 1913, showing marked destruction of the glenoid process of the humerus due to metastatic carcinoma.



Fig. 2. Same case as Fig. 1. Roentgenogram made June 9, 1916, showing marked repair and repair of the case 1 area under roentgen treatment.

at the end of two months shows complete healing with no evidence of malignant disease and no induration of any of the tissues. He is still being kept under observation and given deep roentgenotherapy in the tissues of the floor of the mouth and tongue.

*d Epithelioma of the cheek.* First with out palpable glands. In this group there have been three cases all developed upon the basis of leucoplakia. In only one was a section removed. This showed squamous cell carcinoma. This patient has only recently been treated but seems to be doing well. The other two have remained well two and three years respectively.

Second epithelioma or carcinoma involving the cheek, gums, jaw bone and the submaxillary gland. In this group I have treated a number of recurrent cases and generally speaking the results have been disappointing. One may get temporary improvement but so far all but one of the recurrent cases have been ultimate failures.

*In the primary group in which combined methods of treatment had been used and in which there had been not previous destructive treatment the results have been very encouraging even though the disease is very extensive.* In the paper previously referred to which was read before the American Medical Association June 15, 1916 (20) I reported nine cases belonging to this group in which the disease was very extensive and in which results

were obtained which I believe had not been equaled previously. For details of these cases I will refer to this recent paper. In this paper however I will give a resume of the results obtained in these nine cases and will then report in more detail two of the cases as illustrations of the type of cases treated, the methods of treatment and the results obtained. Of the nine cases reported in the above paper eight patients are free from malignant disease from six months to three years. Of the eight cases there is no reason from anything to be observed at present to expect a recurrence. All of these patients have been observed from time to time by the surgeons associated with me and other surgeons visiting my clinic and all agree that such results could not be obtained by any single method. The ninth case which is dead had been operated upon one month before I was privileged to see him at which time the cervical glands were resected but the growth in the mouth was not disturbed. In other words he was considered inoperable at that time. The patient remained free from microscopic evidence of disease for approximately two months. He then developed a recurrence which was not in the field of electrothermic coagulation but in the field of surgery and from this he ultimately died.

CASE 6. Mr. J. L. I., age 58, was referred to me January 20, 1913, by Dr. H. W. Dachler, roentgenologist Toledo, Ohio, and Dr. H. E. Deemer of

Antwerp, Ohio. He had an epithelioma at the angle of the left side of his mouth about one and one quarter inch in diameter and involving half of the lower lip and a third of the upper lip and the whole inside of the cheek extending to the angle of the jaw. This whole diseased area was destroyed by electrothermic coagulation followed by deep roentgentherapy externally and radium inside the mouth at the angle of the jaw. A course of roentgen treatment was given once a month until all evidence of disease had disappeared February 21, 1914, when we felt sure that all evidence of malignant disease had disappeared at my request Dr. Laplace operated for the closure of his mouth with excellent results and he is still well approximately three years.

CASE 7. Mr W. E. R. age 40 was seen in conference with Dr. Ernest Laplace and Dr. W. L. Shindle June 10, 1915 at which time he had an epithelioma involving the entire inside of the left cheek, the gums on both the upper and lower jaw, the alveolar process of the upper jaw, almost the entire half of the left lower jaw with a mass of metastatic glands in the neck. It had been growing at least eight months. It was considered surgically inoperable by Dr. Laplace. As a result of our conference Dr. Laplace resected the metastatic glands from the left side of the neck. We then destroyed the disease inside the mouth by electrothermic coagulation then resected the left half of the lower jaw and followed by deep roentgentherapy externally and into the open wound with the radium capsule applied under the posterior surface of the upper jaw. In this way we were able to get entirely rid of the malignant disease. Microscopical section removed at the time of operation showed it to be a squamous cell carcinoma. On October 3, 1915, as part of the necrotic bone was separating from the upper jaw a severe hemorrhage developed which could not be controlled until the internal carotid artery was ligated by Drs. Shindle, Gass and Gill. On February 15, 1916 he returned free from malignant disease. The opening in the mouth had healed shut to within the size of a thumb and by wearing a patch over this opening he was able to eat all kinds of food and he had returned to his occupation as traveling salesman. At this time Dr. Laplace sutured the two edges of the opening but there was too much tension and the tissues separated again. A second attempt was made April 15, 1916 with similar result. He returned a few days ago still free from any malignant disease and this time Dr. Laplace has made an effort to close the wound by means of the transfer of a skin flap. We are hoping for a complete success this time and are very much gratified at the good result in the fight against the malignancy.

The general plan in treating this group of cases involves first the total destruction of the diseased tissue within the mouth by means of electrothermic coagulation, the

destruction of any portion of diseased bone the surgical removal of the metastatic glands under the jaw and the resection of a portion of the lower jaw after it has been destroyed or the total resection of half the lower jaw. Then we follow with very active deep roentgentherapy applied externally by crossfiring methods and radium applied internally at the most likely point of recurrence. By the combination of these four methods I am sure that many cases can be made well that otherwise would be considered hopeless.

*Epithelioma of the tonsils.* In this group I have treated four cases. One case which seemed to involve the tonsil by extension downward from the soft palate and the anterior pillar of the fauces has completely recovered and has remained well almost three years. One other apparently recovered and died from intercurrent disease. The third made a temporary recovery but developed recurrence from which he died. The fourth made a recovery and seemed to be free from disease for several months but has now developed metastasis under the jaw and is still under treatment.

*Carcinoma of the larynx.* Carcinoma of the larynx should give good results from roentgentherapy because one need not go through a great amount of tissue in order to reach the diseased area. The treatment should of course be begun as early as the diagnosis can possibly be made. I have treated three cases within the past two years.

CASE 1. Mr F. age 69 was referred by Drs. William Teller and Arthur W. Watson May 20, 1914. This tumor which was located beneath the left vocal cord was regarded by Dr. Watson as an adenocarcinoma. The patient received four courses of treatment within three months each course consisting of twenty five doses crossfiring upon the tumor in the larynx and at the end of this time seemed to be well and has received no roentgen ray treatment since. I have been told that he is still well.

CASE 2. Mr H. M. L. age 48 was referred by Drs. E. B. Gleason and Alex. A. Aaron. He had been suffering from a growth in the larynx for three years. Five weeks before being referred to me, a section was removed and examined by Dr. Funk who pronounced it epithelioma. He improved after the first course of treatment consisting of nineteen doses. After the second course of treatment, which was repeated in one month, he was



improved so much that he believed himself to be well and did not return for treatment for six months at which time he had signs of recurrence from which he died. I believe that he would have had a reasonable chance of permanent recovery if he had reported for treatment at the time he seemed to be well.

The third case was a dispensary patient in whom there was some improvement obtained but he did not recover.

*Sarcoma of the mouth.* In this group I have had under treatment twelve cases. All have shown good results. In one there was metastasis to the spinal column and ultimately death. In another the patient died of general sarcomatous though there was no local recurrence in the area treated. The others have recovered or are improving.

The conclusions that I have drawn from malignant disease about the mouth are

1. The cases forming the basis of this report except those involving the lower lip were almost entirely inoperable and therefore every success is a distinct advance and every failure only a loss of time, energy and effort.

- Any lesion about the mouth which does not show a tendency to heal within a few weeks should be looked upon with suspicion as being malignant and when in doubt should be destroyed or removed.

- I believe that early lesions about the mouth can be destroyed by electrothermic coagulation with less loss of tissue and with more success than by any other means.

- Deep roentgentherapy should be added to any other method of destruction or removal of malignant disease.

- Combined treatment by surgery, electrothermic coagulation, radium and deep roentgentherapy will make some patients well that are otherwise hopeless.

*Recurrent and metastatic carcinoma of the breast and metastasis from carcinoma of the breast.* There is probably no field in which the striking value of the rays in the treatment of carcinoma can be demonstrated so conclusively as in this class of cases for in these cases there can be no question as to diagnosis. In most instances there has been a diagnosis made by a competent surgeon and a pathologic diagnosis by a competent microscopist and when to this are added recurrences and

metastases which in themselves are characteristic and which in most instances are entirely inoperable their disappearance under the action of the rays with no other agent becomes conclusive proof to my mind of the great value of the roentgen rays in the treatment of deep seated malignant disease. Fifteen cases of this class were reported in a previous paper which was read before the Seventeenth International Medical Congress, London August 12, 1913 (17).

In a second paper upon Roentgentherapy in the Treatment of Deep Seated Malignant Disease (21) I added a few other striking cases belonging to this group in which most remarkable results had been obtained. In this paper for the sake of brevity I shall refer only to the cases of metastatic carcinoma in living bone from carcinoma of the breast which I have treated.

In this group of cases so far as I am able to learn good results have not been obtained by any other known method and it forms the most striking and conclusive proof of the effect of deep roentgentherapy upon malignant disease for no malignant disease can be deeper than that involving the bone. While I am reporting some remarkable successes in the treatment of malignant disease it must be understood that I have also had many failures for as will be shown by the cases which I have reported I undertake the treatment of many patients for whom there can be little hope. In practically all the patients there is some improvement. The patients are made more comfortable, pain is relieved, there is a diminution in the disease and I am sure that life is prolonged. In some cases there seems to be a temporary recovery and the greatest hope of complete success is shown and then without known cause a recurrence takes place which one cannot control by any form of radiotherapy. This seems to prove that the malignant cells have developed a certain resistance to the radiation or that in some way we have by means of this extensive radiation reduced the resisting powers of the organism which then succumbs to the disease which develops with rapidity. In all I have treated five cases of metastatic carcinoma to the bone following amputation

of the breast for carcinoma and in all I am able to show the most decided evidence of a healing process

**CASE 1** Mrs B aged 32 came to me September 9 1913 She has been operated on August 20 1913 by Dr John B Deaver for carcinoma of the right breast (confirmed by pathologic examination) and for recurrence March 27 1911 The patient had she had had in all four operations September 19 at the beginning of my treatment the entire operative area on the right side was studded with nodules which were firmly adherent These extended to the axilla, and in the right axilla there were masses from one half to three quarters inch in diameter firmly binding the tissues There were large nodules in the supraclavicular region of the right side The left breast contained a mass of tumor tissue with retraction of the nipple with metastasis in the left axilla and in the left supraclavicular region There were two small nodules in the scalp About three inches of the second left rib and a small area of the third rib were destroyed and about an inch and a half of the right tenth rib with disease of the eighth, ninth, and tenth dorsal vertebrae the fifth lumbar and the upper part of the sacrum Ordinarily such an extensive distribution of disease would preclude even the thought of accomplishing any good results but this patient had an unusual amount of determination to get well I therefore decided to see what could be accomplished She has received an enormous amount of treatment over the entire body during the past three years 325 doses averaging about 20X or amounting to 6500X As a result she has gained 20 pounds in weight She gradually became able to look after her household duties and is now doing all her housework She looks and acts very much stronger All the nodules on her right chest have disappeared, as well as those in the right axilla and the right supraclavicular region The mass in the left breast has shriveled, and while there is considerable retraction of the nipple, the area feels like fibrous tissue and is freely movable The metastases in the left axilla and supraclavicular region have disappeared The disease in the second rib has healed so completely that I believe an untrained man could not find the evidence of any previous disease in the rib nor in the dorsal vertebrae I believe the disease in the vertebra has healed The disease in the fifth lumbar vertebra and sacrum is at present giving the patient most of her symptoms yet both show a most decided evidence of a healing process The diseased area has become refilled with lime salts and I believe from the present evidence at hand that this will probably heal completely

In this case we are undoubtedly dealing with a general carcinomatosis and the chances of ultimate failure are very great

but so far there has been progressive improvement and the results have been the most remarkable of any that I have ever seen (Figs 1, 2, 3 and 4)

**CASE 2** Mrs M age 48 referred by Dr John B Deaver October 8 1914 had had her right breast amputated September 22 1913 She had noticed a tumor for nine months For five months preceding the operation she had received some roentgen ray treatment in another city without improvement Following the operation she received some postoperative treatment near her home At the time she was referred to me she had a recurrent carcinoma half the size of a hen's egg, firmly attached to the third and fourth ribs and the interspace between them The patient was given eight full doses of rays through eight different areas of skin each dose of filtered rays representing 20X = 160X<sup>1</sup> This series was given October 28 November 18 December 14 and January 18 When the last series was given the tumor had disappeared The patient had had in all from us four series of treatments the last one being given as an additional precaution

Up to the present time there has been no recurrence nor any evidence of malignant disease in the area of her chest treated and the recurrence for which she was referred to me has entirely disappeared The skin is healthy All this despite the fact that there has been extensive metastasis elsewhere in the body and this fact leads me to believe that the metastasis probably took place before the X ray treatment was begun On April 27 1915, the patient consulted Dr Deaver who again referred her to me on account of a tumor which had developed in the right side of her forehead and which was about three fourths inch in diameter This was hard, firmly adherent and both Dr Deaver and I looked upon this as metastatic carcinoma The patient refused treatment however and returned three months later with symptoms of spinal involvement At this time the tumor was present on the forehead and X ray examination showed disease of the seventh, eighth, ninth, tenth, eleventh and twelfth dorsal vertebrae and of the tenth rib on the left side and the eleventh rib on the right side Treatment was then directed toward the forehead and over the spinal column and one course of treatment was given each month September 1915 she was brought to the hospital for treatment on a stretcher Her spine was so tender and she suffered so much pain on movement that she had to be lifted about on pillows There did not seem to be enough strength to support her own body X ray examination showed, in addition to the lesions previously described disease of the

One X = Kienboeck unit (measured by definite shade of photographic effect on special photographic paper recommended by Kienboeck) of unfiltered rays = an erythema or suppurative dose X = tint B of the special but non-platin-cyan d d is (Souraud and N. 19) 20X can be given without producing burns because of thorough filtration and the use of hard rays

right shoulder joint with destruction of the glenoid fossa and a portion of the head of the humerus with a focus of disease in the left glenoid fossa. She had evidence of carcinoma of the lung. There were nodules present in the skin of the abdomen. In other words, there seemed to be a general carcinomatosis. The patient received another course of treatment covering practically the entire body and comprising about 30 doses. This was repeated once a month until April 1916 when she was able to walk out of the hospital and was reasonably comfortable. She has been given one course of 1003 doses in June 1916 traveling 30 miles and during the trip very ill. X-ray examination showed no complete healing of the right shoulder, healing of the ribs and healing of the vertebrae. In Case 1 there can be no assurance that this patient will ever completely recover but with this remarkable improvement we are surely justified in going as far as to and recovery (Figs. 6, 8, 10).

Case 4. M. S. I. age 34, married, married in 1905, July 9, 1905, she had her right breast removed for carcinoma. On year after the first operation she was treated by Dr. DeWitt on account of recurrence of the disease in the left breast. The metastasis in the right breast was also removed. The right breast was removed by the method of the late Dr. DeWitt. The patient was then given one course of 1003 doses covering practically her entire body during the month of November and another during the month of December. She was then sent to Michigan with instruction not to return for I looked upon the case as practically hopeless. She however returned against my advice January 13, 1916 at which time the right arm was swollen to its normal size and the roentgenogram showed marked destructive disease of the head of the right humerus, the right glenoid fossa, the left lung, the left glenoid fossa in addition to the extensive disease of the vertebrae. The patient was then given a course of treatment during the months of January, February, March, April and May at which time she returned to Michigan with marked general improvement. In January she was absolutely bedfast. In May she was able to stand up and probably would have been able to walk though I was afraid to let her walk

for fear of fracturing her spine. The nodules on the anterior surface of the chest had decreased in size. The swelling of the arm was reduced probably 50 per cent. The head of the humerus and glenoid fossa on both sides had nearly healed. The vertebrae and sacrum showed distinct evidence of healing. She was allowed to go home May 27, 1916 (Figs. 1 and 2).

Case 4. Mrs. J. G. M. age 52 was referred to me by Dr. William F. Rink and Dr. Gustave VanLennop April 8, 1916. In 1909 Dr. Charles Noble had amputated the right breast for carcinoma. A trouble had developed from it since. Had an operation for some ovarian condition in 1908. Three months before she was referred to me she had fallen downstairs injuring herself in the back of the neck. About a week later neuritis developed all through her head. By physical examination I found a swelling about the back of the neck the head being set very low upon the shoulders and a general stiffness together with continuous pain. She reported herself as being more comfortable when lying down. X-ray examination showed decalcification and compression of the second, third, fourth, fifth and sixth cervical vertebrae. The length of the spine with first and

the third vertebrae almost completely healed and the whole lumbar vertebrae had the appearance of a cast in cement. There was a mass of abscesses about the spine when eggs were laid. The first in second cervical vertebrae. A course of treatment was ordered of seven weeks given from 1800 to 1900. At this time she was discharged as reported good. Three weeks later she was able to walk and go to work. She was able to go to work and go to the home. At the end of eight weeks when she reported for the third course of treatment she was free from pain. She was able to go about comfortably traveled fifteen miles. X-ray examination showed distinct evidence of recalcification of the vertebrae.

Case 5. Mrs. M. McW. age 41 was referred to me March 6, 1916 by Dr. Stillwell Burns. Six weeks previously Dr. Burns had amputated both breasts, one showing carcinoma and the other without normal involucre. She had returned to her home several weeks previously and while hastening upstairs she had a fracture in the lower third of the thigh which upon X-ray examination was found to be inolved by metastatic carcinoma. After conference with Dr. Burns I decided to place her thigh in a fracture box and then treat it through the dressings by means of the roentgen rays. A month later when examined we found distinct evidence of callous formation and recalcification of the diseased area. No X-ray treatment had been given elsewhere in the body. At the end of six weeks she returned to her home. The fracture seemed to be united as determined physically and by X-ray examination. Soon after reaching her

some she developed signs of visceral disease and died. The lower end of the femur was resected at postmortem and on June 16 1915 another X-ray study was made of the resected bone which showed complete healing and certainly as healthy as could be expected in the average bone in a woman of his age in that period of time. It was our intention to have this bone sectioned and examined microscopically but through the misunderstanding on the part of one of the nurses it was thrown into the waste can and lost.

A review of these five cases of metastatic carcinoma of the bone establishes beyond the slightest doubt the healing value of the roentgen rays in carcinoma. One who is extremely skeptical might attribute the healing in a single case to the natural resistance of the body but when these four cases are reviewed that argument cannot hold and the argument of spontaneous recovery without the use of the rays cannot hold when we consider the last case in which only the femur was treated by the roentgen rays and in which the femur recovered and the patient died of carcinoma elsewhere.

*Carcinoma of the thyroid.* CASE 1 was a young woman of 36 who had been operated upon three times previously for carcinoma of the thyroid and was referred to me by Dr. John Deaver June 14 1910 for a third recurrence. She had been operated on for carcinoma of the thyroid July 1908 and for recurrence March 1909 and May 6 1910. June 14 1910 when referred to me she again had a recurrence and Dr. Deaver considered it unwise to operate further. Active treatment was begun and June 30 1911 she seemed to be free from disease. September 9 1911 she returned with pain in her right cervical region. This pain increased and roentgen examination December 6 showed metastatic carcinoma in the second cervical. From this metastasis she died July 6 1912 but there was no recurrence of the disease in the thyroid.

This was an ultimate failure but I look on it as a brilliant temporary result for the rapid recurrence after the third operation was completely controlled. The metastasis in the cervical spine may have taken place at any time previously—probably before my treatment.

CASE 2 Mrs. L. S. age 46 was referred by Dr. John B. Deaver February 10 1913. Dr. Deaver had removed a carcinoma of the thyroid two weeks previously (confirmed by microscopic examination). He was unable to remove all of the disease and so stated when he referred the patient. She was given

fifty six full doses between February 10 1913 and December 2 1913 at which time she seemed to be well. There has been no recurrence of the disease since. About a year ago she was operated on for fibroma of the uterus with hyaline degeneration and a fibrocystic tumor of the right ovary which was malignant. It would seem probable that this was an independent affection and the result in the disappearance of the remaining disease which was known to be present following the operation in the thyroid gland is another very strong argument in favor of postoperative treatment. This patient has been seen within a few months and is so far as anyone can tell well today which is over three years since she was referred for treatment with some of the malignant disease having been known to be left behind by Dr. Deaver as impossible for removal.

*Carcinoma within the abdomen.* For many years treatment of this group of cases has been abandoned. With the new impetus given by the development of the crossfiring method and the filtration so as to obtain more satisfactory deep results the work was taken up anew. The cases reported however chiefly involve the uterus and in this field some excellent results have been obtained. In general however we may conclude that the proper treatment for carcinoma of the uterus is surgical removal when possible and this surgical removal should be followed as promptly as possible by thorough postoperative deep roentgen therapy. To the inoperable cases one may offer some hope of a cure some benefit in practically all in lessening hemorrhage and pain and at least temporary improvement by a thorough course of skillfully applied deep roentgentherapy.

Malignant disease involving the intestines I believe should be dealt with surgically so far as is possible and then followed immediately by a thorough course or courses of deep roentgentherapy. To illustrate this type I will report one case.

Mr. H. A. age 30 was referred to me for treatment April 6 1914. He had been operated on February 4 by Dr. Babcock for carcinoma of the sigmoid with metastasis. Ten inches of the sigmoid was resected and the neighboring glands removed. He was given thirty four full doses of rays between April 6 and April 9. This series or this course of treatment was again repeated May 23 June 24 August 3 1914. Since this time he has had no treatment. He has remained perfectly

well and is working daily. Roentgen examination showed slight irregularity in the sigmoid but nothing that would suggest carcinoma.

I believe that the rays were influential in preventing recurrence and further metastasis and he has remained well approximately two years and a half since the operation for carcinoma of the bowel with metastasis. This I believe forms a strong argument in favor of postoperative treatment.

*Carcinoma of the stomach.* Early in my work I treated a number of cases by the imperfect technique used but I have never seen any good results except in one case in which there was undoubted disappearance of the tumor. This case was reported in my previous paper (21). Recently I have treated a few more cases. There has been some improvement but I cannot hold out much hope from my own experience in the treatment of this group.

*Deep seated sarcoma.* It has been my experience that sarcoma yields very much more readily to deep roentgentherapy than does carcinoma and my results reported in previous papers (12, 16, 22) and other cases that I might add would confirm this view and leads me to expect recovery in at least 50 per cent of the cases. This increased sensitiveness to the roentgen rays of sarcoma over carcinoma as observed by myself corresponds to the experience and microscopical studies by Clunet and Raulet Lapointe in which they found the sarcomas three or four times as sensitive as the carcinoma. The length of this paper will not permit any detailed reports of this group of cases though the results obtained are very much more brilliant than those obtained in the treatment of carcinoma.

#### CONCLUSIONS

1. Malignant disease should be so far as possible completely removed surgically or they should be destroyed by electrothermic coagulation.

Each operation for malignant disease should be followed by postoperative roentgen treatment. The extent and character of this postoperative treatment will depend on the location of the disease.

3. When there is an absolute necessity for delay in operation from some other cause the patient should be treated by means of the roentgen rays and this treatment should be especially directed toward the glandular area. This will reduce the malignancy and I believe help to prevent metastasis.

4. Inoperable cases should always be given the benefit of the rays. Some of them will be removed and others made operable and all will be made more comfortable and I believe life prolonged.

5. Local recurrences yield to roentgen therapy fairly well and some of these patients I believe can be made permanently well.

6. Metastatic carcinoma even when it affects the bones has been shown to heal in at least four cases.

7. A skilful combination of the best methods known in the treatment of malignant disease will accomplish more than any single method.

8. Thorough and intelligent application of the methods known today for the treatment and removal of precancerous lesions and for the prevention of malignant disease will do more in the fight against malignant disease than all combined methods after the disease has developed.

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## THE FIELD OF NEUROLOGICAL SURGERY IN A GENERAL HOSPITAL

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IN June, 1913 the department of neurological surgery was organized at the Polyclinic Hospital; this paper is merely a report of the work of this department during the past three years. June 1, 1913 to June 1, 1916 it is published to show the great need of a special department of neurological surgery in many of the large general hospitals in this country. This hospital is the first general hospital to organize such a department maintaining both an out-patient clinic and a regular operative clinic three times a week. The patients referred to its out-patient department have been so many that the clinic is now held daily; naturally many patients are referred to this department both in the clinic and in the hospital who cannot be benefited by any operative procedure and are therefore referred to the neurological or medical departments.

Owing to a better understanding of the pathological processes and to an improved operative technique the field of neurological surgery has been very much enlarged during the past ten years. Certain neurological conditions which were formerly considered as being practically hopeless have been so

benefited and in many cases entirely cured that it is our belief that there are still other so-called hopeless cases which will be successfully treated. Contrary to the general opinion regarding the mortality of neurological operations we are glad to state that the mortality has been surprisingly low. Naturally the end results of brain tumors are bad; as almost 80 per cent of them are malignant an accurate diagnosis is rarely made early and if an operation is finally advised the impairment both mental and physical resulting from the tumor growth and its operative removal from an area difficult of access is considerable—it is rare for such patients to be able to resume their normal activities. If neurological surgery consisted chiefly of the removal of brain tumors then it would be a most discouraging field of work; fortunately however the treatment of brain tumors forms but a small percentage of neurological surgery.

It should be stated that a permission for autopsy is obtained *before* operation from all of our patients in this department, both private and ward patients; so that if a patient should die following the operation then not

only will the cause of death be ascertained but the accuracy of the diagnosis will be determined. Future patients will then obtain the benefit of such findings and we feel that this procedure has been most helpful. Other wise the groping on in the dark continues.

The following is a brief summary of the work with an occasional remark.

Total number of patients admitted to outpatient department	96
Total number of patients admitted to hospital	94
Total number of patients operated upon	500

ACUTE FRACTURES OF THE SKULL	
Total deaths	6
Total patients operated upon	
Total deaths after operation	
Total patients operated upon	4
Total deaths	4

That is a total mortality of 50 per cent if however the moribund patient are eliminated then the mortality is only 16 per cent. Regarding moribund patients as is common in institution centrally located with an active emergency and ambulance service many patients have been received that were moribund or have died within two hours. This was the cause of death of 34 patients in whom the diagnosis of fracture of the skull was only incidental to other injuries such as fracture of both femora and humeri, internal injuries, crush of the chest, fractured pelvis and the like. The patients dying in shock (other cases are included in which the primary laceration of the brain has been so severe as in itself to cause death within three hours).

Of the non-operative deaths 8 were due to basilar meningitis (the diagnosis being confirmed at autopsy in 8), 3 were associated with a condition of cardionephritis while the others died of shock from their numerous injuries.

Of the 21 deaths following operation 12 of these disclosed such extensive cerebral lacerations that recovery could scarcely be expected. 4 were operated upon while in severe shock (poor surgical judgment), 3 deaths occurred from infection and 2 from pneumonia.

In the first part of this series in 1913 several patients were operated upon as a forlorn hope in the belief that an operation would give them a chance to recover. We believe now it

is unwise to operate upon a patient in severe shock with a pulse over 120 and a rising temperature even though he may show definite signs of intracranial pressure. The patient is given his best chance by treating the condition if he can first if he cannot survive the shock then an operation will surely not help him. In this series of 6 acute fractures of the skull only 75 were operated upon that is in only 33 per cent. An operation seemed advisable.

An interesting observation is the fact that two of the operative deaths occurred from infected hematmata, one of the face and the other of the scalp, both far distant from the lesion. *Deceptive* *Deaths* occurred after the operative wound had healed by primary union both were autopsied and showed a purulent meningitis localized in each case following the cut of the hematoma. The decompression was unilateral and adjacent brain very firm and bled but lately no trace of any infection. All large hematmata of the scalp in fracture of the skull should be incised evacuated and drained.

One of the operative deaths we regret to state died from meningitis due to infection of the wound and emphasized the need of a thorough and efficient preparation of the operative field and a most strict aseptic technique in the treatment of many fractures of the skull is emergency work and therefore the risk is greater. In another series of cases of which 236 subtemporal decompressions were performed only 3 infections occurred, all of these cases were prepared 12 hours before operation.

The ophthalmoscopic finding, the condition of the optic discs and retinal vessels, the pulse, temperature and blood pressure and above all lumbar puncture with a measurement of the pressure of the cerebrospinal fluid are considered the best clinical evidence of the need of any operative procedure. The diagnosis of a fracture of the skull is aided by a combination of history, oozing of cerebrospinal fluid from ears, nose or mouth, localized ecchymoses, paresis or paralysis, disturbance of the reflexes, X-ray and other clinical signs. Many more skulls are fractured than is ordinarily believed.

(that is latent fractures) and one may only too often be surprised by the extent of a fracture as shown by X ray or disclosed by operation which has given rise to few or no cerebral signs this again strongly emphasizes the fact that an operative procedure is to relieve the brain injury by lessening the intracranial condition of hemorrhage cerebral edema with the resulting increased intracranial pressure rather than for the fracture itself in fact the fracture is really the least dangerous factor and frequently it affords an outlet to the increased intracranial pressure by allowing the blood and cerebrospinal fluid to escape so that the patient will recover without any operative procedure the condition of severe shock should be treated first and then if an ophthalmoscopic examination reveals signs of increased intracranial pressure to the extent of blurring the nasal halves of the optic discs or even more a pulse around 60 with the cerebrospinal fluid under high pressure at lumbar puncture an operation should be advised as being the safest procedure not only to save the life of the patient but to avoid the danger of post-traumatic conditions so common after fractures of the skull A subtemporal decompression is performed upon the side of the apparent cerebral lesion and if the intracranial pressure is extremely high then a bilateral decompression is performed at the same time in order to lessen the intracranial pressure still more A right subtemporal decompression in non localized lesions is preferred in right handed persons to avoid the motor speech area of the left cerebral cortex A vertical incision is used, this route and method of crural decompression is preferred to all others since it drains the base of the skull very effectually through the middle fossa the decompression opening is covered by the thick temporal muscle so that there is no danger of hernia and finally it exposes the right temporo-sphenoidal lobe which is essentially a silent area of the brain and therefore any operative damage to the underlying cortex is not serious the middle meningeal artery so frequently injured at the time of fracture can also be observed

## CONCUSSION

Total number of patients admitted	80
Average stay in hospital	2 1/2 days

These cases are treated expectantly they usually recover very quickly

It should be noted that 21 of these patients complained considerably and insistently of violent headache vertigo nausea and vomiting A lumbar puncture was done both as a therapeutic and diagnostic aid and in each instance the patient was definitely relieved five of these patients although not knowing the moment the fluid was withdrawn nevertheless expressed marked relief the moment the flow began In all of these patients the fluid was under pressure and in six patients the tension was extreme This increase of cerebrospinal fluid—the so called cerebral edema—we believe is due either to a hemorrhage of the normal excretion of the cerebrospinal fluid over the cortex or to an increased secretion of the fluid so that the subsequent accumulation of the excess fluid produced meningeal tension and therefore the headache with the other mild signs of increased intracranial pressure In these cases of concussion the increased intracranial pressure was never sufficient to blur the optic discs—merely a dilatation of the retinal vessels and in some severe cases a blurring of the nasal margins of the discs The regular routine treatment consisted of the following the usual treatment for shock with coffee by rectum icebag (helmet) to head absolute rest and quiet in bed morphin if necessary temperature and pulse every hour for six hours light diet and daily catharsis These patients report every two months for observation—all work being prohibited

#### OLD FRACTURES OF THE SKULL (6 MONTHS TO 16 YEARS)

Total admitted	4
Depressed fractured vault	2
Fractured vault (not depressed)	10
Fractured base	10
Operated upon	32
Died (infection)	1
Oldest fracture from date of injury	16 years
Most recent fracture from date of injury	6 months
Average length of time since injury	3 years

An analysis of the chief symptoms complained of by these 42 patients is as follows—



Persistent headaches	8
Changes in personality	5
Early fatigue	7
Jacksonian epilepsy	9
Paralysis of part is	5

This group of post-traumatic cerebral conditions is the result of a definite brain injury either primary or secondary to increased pressure and should emphasize the danger of that too oft diagnosis of "traumatic neurosis." It also reminds us that we are fully justified in explaining to the patient or to his relatives in recent cases of fracture of the skull with definite signs of increased intracranial pressure that an operation is advisable not only to save the life of the patient primarily but also to relieve the increased intracranial pressure and thereby lessen the danger of the development of the post-traumatic conditions which in themselves may cause endless annoyance and distress.

Many of these patients had had a depressed fracture of the vault. Operative procedure is advised in every case of recent depressed fracture of the vault for we are confident that the depression itself is a serious menace. The dura in these cases is not opened unless there is abnormal tension. In 9 of the cases that showed marked intracranial pressure a subtemporal decompression was performed just before the depressed area of the vault was removed.

Many unusual pathological conditions were exposed by operation. In one case a piece of wood (3 cm x 1 cm) was found imbedded in the frontal bone of a miner who had fractured his skull five years before. In another case of six months duration a mass of hair was found in a comminuted fracture. In six cases traumatic cysts of the cortex were found due to supracortical hemorrhage following the injury. In one patient numerous varicosities of the dura were ligated and partially removed.

The average duration after injury was three years. In all of these patients the definite signs of increased intracranial pressure were detected by the ophthalmoscope and confirmed by a measurement of the cerebrospinal fluid at lumbar puncture. In nearly all there were localizing signs of irritation.

Naturally many patients were examined which did not show the signs of an increased intracranial pressure and therefore an operation was not advised that is the diagnosis was a condition of traumatic neurosis.

It is too soon to determine the permanent results of these operations but it is long enough to measure in a rough way some of our results. The patient in whom epilepsy was the chief complaint will be discussed later in this paper. Headaches of the 18 patients 14 have been entirely relieved. Fatigue of the 7 patients who were unable to work because of this distressing symptom 5 are now back at their work. Changes in personality probably due in many cases to a prolonged increase of the intracranial pressure of the 5 patients examined 2 have improved. Of the 3 patients in whom paralysis occurred 1 has entirely recovered the other 2 have shown little if any improvement.

All of the patients giving a definite history of injury and followed by the above symptom complex should be thoroughly examined for evidences of an existing increased intracranial pressure. This is particularly true in cases of old depressed fractures of the vault in the hope that localizing signs may be elicited.

#### OBSERVATION

Total admitted

8

More than half of these cases were admitted with a diagnosis of possible fracture of the skull. Besides the routine physical examination including the ophthalmoscopic findings a lumbar puncture and X-ray were used on every doubtful case and it is surprising the number of so called latent fractures of the skull that are thus demonstrated that is a fracture of the skull giving no definite cerebral signs. Naturally these latent fractures are not operated upon merely the expectant palliative treatment. The use of the X-ray does not help in the treatment of fracture of the skull—it merely makes possible a more accurate diagnosis. No patient with definite signs of high intracranial pressure following a severe injury to the head should be allowed to wait and the operation

delayed in order that an X ray picture can be obtained such a picture might satisfy our curiosity as to the presence or absence of a fracture and yet the treatment is the same whether there is a fracture or not besides X ray pictures of the head especially in fractures of the base are rarely helpful An X ray picture is really the least important aid in the treatment of brain injuries

#### FRACTURES OF THE SPINE

Total admitted	13
Operated upon	8

Only 6 of these cases were acute fractures 4 of these made excellent recoveries the paralysis gradually disappearing so that 2 of them can walk

The other 7 patients were old fractures and thus again emphasizes the point that all acute fractures of the spine giving definite signs of compression of the spinal cord and yet the vertebral dislocation is not so great as to make the severance of the spinal cord a certainty should certainly have an exploratory laminectomy Only too frequently a patient with an acute fracture of the spinal column shows all the signs of a complete transverse myelitis and yet later some motor power returns and demonstrates that there was still a number of spinal nerve tracts in continuity—merely compressed The too often 'careful and watchful waiting' policy is many times responsible for the delay that is most harmful In cases of complete transverse myelitis due to pressure and a severance of the spinal cord naturally nothing can be hoped for but in many acute cases this apparent transverse myelitis is the result of a compression rather than of a primary destruction of the parts of the spinal cord at the time of the accident, and if this compression is removed shortly after the accident the ultimate improvement will be much greater that is an exploratory spinal decompression is advisable in selected acute fractures of the spine in the hope that the spinal cord is merely compressed and not irreparably damaged The dura is always left open to insure a real decompression The operation itself is technically very simple and of comparatively little risk

#### TUMORS OF THE BRAIN

Total admitted		36
Operated		31
Died in hospital after operation		6
Type of growth	Type of Operation	
Glioma	Osteoplastic flap	11
Sarcoma	Subtemporal decompression	12
Tuberculoma	Single decompression	5
Pituitary	Bilateral decompression	7
Cysts	Cerebellar decompression	8
Unknown		5

This field of neurological surgery is most discouraging at the present time The diagnosis is difficult to make early and with rare exceptions the localization of the tumor is still more difficult Besides these tumors are usually malignant and therefore they recur However the brilliant success one occasionally has in pulling out of the fire as it were, a hopeless case more than counterbalances the disappointment of the less fortunate cases An earlier diagnosis will be of the greatest help

Of the so called fortunate cases a few have entered this clinic A case of pituitary tumor has been relieved and its symptoms have subsided a large glioma removed after four recurrences has not shown any evidence of its return during the past 11 months 3 osteo sarcomata involving the frontal regions have not had a recurrence in the past two years and 3 cysts of the cerebellum have not returned during the same time Three patients with unlocalized cerebral tumors in which the definite signs of increased intracranial pressure were producing choked discs with visual impairment have cleared up with simply the operation of a bilateral subtemporal decompression Patients should not be permitted to become blind as the results of a secondary optic atrophy due to high intracranial pressure merely because the tumors cannot be localized an early decompression is advisable to save the vision in the hope that the tumor will later localize itself and so be removed and yet the patient be not blind—a most discouraging condition

#### ABSCESS OF THE BRAIN

Total number of patients admitted	11
Total number of operations	9
Total number of patients died	4

Light of these cases resulted from otitic diseases two from fractures of the skull and

one was metastatic. The treatment of this condition has been described elsewhere.

#### TRUNCAL NEURALGIA

Total patients admitted	6
Patients operated	
Type	
Facial	1
Brachial	1
Others	4

The results obtained in this condition are most satisfactory. The genuine appreciation of the sufferers of this *doloureux* is quite characteristic and is well worth the added difficulty and oftentimes technically intricate and painstaking labor required to remove the ganglion. It is seen rarely. The danger of this peritonitis is slight. In each case there has been complete relief, no return of the symptom except in two cases where the branches were merely cut intracranially without the peritonitis of the patient.

The technique of the operation for removal of the ganglion has been the subject in which operation is patient because of the anatomical location of the ganglion. It is usually bony and removal is rendering it technically very difficult and finally the peritonitis of the patient warranted only a thorough division and microsection of the ganglion. In the majority of cases it is not necessary to remove the ganglion in order to obtain a good exposure of the ganglion in only one case was it deemed necessary the patient weighing 200 pounds and having a very hard face. Ordinarily the presence of the ganglion is not usually hamper the exposure of the field and it does not allow marked deformity of the patient to occur at the operative site. When alcohol injection have been used previously not only was more hemorrhage encountered in approaching the ganglion but it was a much more difficult procedure probably due to the new formed vascular and connective tissue stimulated by the irritation of the alcohol.

#### PERIPHERAL NERVE ANASTOMOSIS

Total patients admitted	10
Patients operated	
Type	
Facial	8
Brachial	5
Others	6

Laryngoscope 61 24

This phase of neurological surgery is particularly interesting and most encouraging. The complete dissection necessary to expose the lesion and its anatomical study combined with a definite pathological condition with its clinical variations form a fascinating field of work.

Peripheral brachial birth palsies headed the list. Eighty-one were operated upon and of these the fifth and sixth roots were found impaired in 62, the seventh in 3, and the eighth and first dorsal roots were found damaged in 19. Naturally there were various combinations, even the entire plexus being ruptured though rarely. The ages ranged from one month up to fifteen years. The usual lesion was a dense connective tissue formation blocking the plexus and thus impairing its function usually of the upper arm type of paralysis.

One month is the ideal time for the operation if the paralysis of the arm is complete. It is not complete then, in which stage it is marked improvement has occurred. In all but a few cases exploration should be made to ascertain the condition of the plexus. The postoperative treatment holds the arm over the head by means of adhesive strips for a period of three months and then regular massage and exercise are given.

In the 8 cases of facial paralysis the distal end of the facial nerve as it emerged from the stylomastoid foramen was anastomosed to one half of the adjacent hypoglossal nerve care being taken to get a full dissection of both nerves so that there should not be any tension whatsoever.

The other anastomoses included the following: 6 of the median nerve, 3 of the ulnar nerve, 2 of the musculospiral nerve and 1 each of the anterior crural nerve and the inferior and recurrent laryngeal nerves following an injury. In this work of nerve anastomosis it is absolutely essential to resect and pare the nerve ends free of all scar tissue otherwise a return of nerve function will not be possible because the delicate nerve fibers will be unable to grow down through this scar tissue formation the cause of many bad results in peripheral nerve anastomosis.

# HYDROCEPHALUS

Total number of patients admitted	28
External hydrocephalus	10
Internal hydrocephalus	9
Total number of patients operated upon	1
Single decompression and drainage	8
Double decompression and drainage	10
Total number of patients died	8

In this group of cases a new method of intraventricular and subdural drainage through the subtemporal route has been instituted. These cases apparently so hopeless from both a surgical and medical standpoint are now particularly inviting in their appeal for relief especially in view of the experimental work now being conducted. Concerning the method of drainage just mentioned a full report will be given in the near future. Although sufficient time has not elapsed to warrant stating that the condition in the patients has been permanently overcome nevertheless in 14 cases the improvement has been marked and 5 patients who were formerly unable to move their heads from the pillow are now walking. Regarding the 8 deaths in this series of 27 patients operated upon 2 died of pneumonia two and six days respectively after being discharged from the hospital and more than two weeks after the operation.

The great frequency of external hydrocephalus as compared with the internal type has been very surprising in each case the ventricles were punctured and in 19 of the 28 patients the ventricles were found not to be dilated that is we were dealing with the external type of hydrocephalus with no blockage of the ventricles.

# SPINA BIFIDA

Total patients admitted	12
Total patients operated upon	11
Total patients died	3

Eleven cases of spina bifida were operated upon. In 5 of them there was an associated hydrocephalus which was drained as described above 3 of the cases died—1 of them from pneumonia on the twenty second day post operative. Four of these cases have improved markedly though it is still too early to comment upon the end results. We believe that spina bifida is due to the same causes producing hydrocephalus that is a blockage

of the excretion of the cerebrospinal fluid thus an increased intracranial pressure results producing a protrusion of the spinal canal in the region which closes the latest that is in the lumbar area. If the pressure is very high then a hydrocephalus may also occur. If the increased intracranial pressure occurs after the complete closure of the spinal canal then a spina bifida does not occur only the hydrocephalus. That is spina bifida is not a defect but rather the result of increased intracranial pressure.

# CEREBRAL SPASTIC PARALYSIS

Total number of patients examined	1026
Hemiplegia	11
Paraplegia	38
Diplegia	86
Patients admitted	531
Patients operated upon	236
Single decompression	187
Bilateral decompression	49
Patients died	0
Mortality percentage	0

Special work has been done in this department upon selected cases of spastic paralysis. Only selected cases of true cerebral spastic paralysis due to birth traumatism with its resulting cortical hemorrhage and showing definite signs of an existing increased intracranial pressure by ophthalmoscopic examination and confirmed by the measurement of the pressure of the cerebrospinal fluid by lumbar puncture are considered. Cases of Little's disease due to agenesis of the cortex malformations and lack of development of the brain and its pyramidal tracts and conditions of spasticity due to the various forms of meningitis are easily excluded by a careful history ophthalmoscopic examination and lumbar puncture. Obviously these latter cases do not and cannot show signs of an increased intracranial pressure so that any cranial operative procedure for them would be but a needless risk and could in no possible manner benefit the condition.

A single or double subtemporal decompression is performed in the attempt to relieve the existing increased intracranial pressure of the hemorrhagic cyst like formation on the cerebral cortex—the remains of the primary supracortical hemorrhage that is the cerebral impairment is secondary to

the pressure of the hemorrhage and not due to a primary destruction of nerve cells as formerly believed.

In this series of 1036 examined patients 230 were operated upon that is about 1 out of every 4 patients examined showed definite signs of increased intracranial pressure and were therefore the selected cases that could be benefited by a lessening of this intracranial pressure. The usual age of the children has been between 2 and 6 years naturally the younger the child the greater chance there is for improvement. A number of observations regarding the pre operative and postoperative care of children with this complaint will soon be published.

The results in these selected cases of spastic paralysis have been very satisfactory both physically and mentally and in only 13 patients has there been no improvement. Of the 20 patients who died after the operation 9 of them were under two years of age and of the extreme diplegic type being very poor operative risks owing to their emaciation and great difficulty of swallowing.

#### EPILEPSY (THE CHIEF COMPLAINT)

Total number of patients admitted	90
Pathology —	
Meningo-encephalitis	4
Old fracture of skull	9
Spastic birth palsy	66
Tumor of brain	8
Unknown	26
Included elsewhere	3

The condition of epilepsy is at present such a hopeless condition that its surgical aspect is considered very frequently in the hope that something can be done to lessen the severity and frequency of the attacks at least it was thought best to include a separate series of all cases admitted to the service with epilepsy as the most prominent symptoms.

All of these patients operated upon were selected ones who showed distinct evidences of increased intracranial pressure and in whom thorough medical treatment had been used and had failed to improve the condition.

The type following an old encephalitis of childhood was very interesting and its pathological picture of thickened vascular dura thickened pia arachnoid network of new formed tissue and vascular trees superimposed on the cortex smoky induration of cerebral vessels was very marked. 10 of these children were operated upon in only 2 of them had the convulsions apparently been permanently improved.

Besides the cases of spastic paralysis the most encouraging results have been in the old fractures of the skull in whom 5 of the total of 9 cases the epilepsy has apparently disappeared.

Attention is again called to the point that the cases operated upon are selected ones only—according to the presence of a marked increased intracranial pressure and with definite localizing signs. The operative effort is to relieve that pressure and possibly change or modify the cerebral vascular equilibrium. Routine operative treatment in the usual cases of epilepsy is of course condemned. In the majority of these patients the Jacksonian type of epilepsy of a localized lesion has been prominent.

#### APOPLEXY

Total patients admitted	2
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Cases were referred to this department in the hope that the hemorrhage might be of ventricular type or of the supracortical type in which operative interference by drainage is indicated. However none of the patients at this hospital were of this type and therefore were not operated upon.

Besides the above cases there were ones due to thrombosis of the cavernous sinus nerve compression due to a cervical rib tumors of the spinal cord and then a number of patients whose condition we could not satisfactorily diagnose. The assistance of Dr C S Hunt as anesthetist and of Drs H B Dunham and Y C Lott has made it possible for this work to be performed.

## HÆMATOCOLPOS HÆMATOMETRA, AND HÆMATOSALPINX IN A WOMAN OF SEVENTY-FOUR YEARS

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**I**N the case to be recorded in the following a condition of absorbing interest and extreme rarity revealed itself

The patient was 74 years of age. She had never been pregnant. Her menstruations had all ways been normal until about 35 years ago when she entered the climacterium. She had had no vaginal discharge of any kind since then. At the age of 67 she was operated upon for cystocele. Dr. W. V. Laws of Hot Springs, Arkansas, who performed an anterior colporrhaphy, informed me that the senile atrophy of the uterus was quite noticeable at the time. There ensued a period of almost seven years of good health until two and a half months ago when she complained of painful sensations which originated in the lumbar regions and extended into the groins and toward the bladder. This pain which occurred in the form of attacks had at first the character of a dull ache, but had gradually become more severe particularly in the region of the bladder where it assumed paroxysmal proportions. The attacks increased in frequency and for the last week or two occurred daily. Position of the patient or exertions seemed to have no bearing on their occurrence. There was a peculiar regularity about these attacks in that they appeared only between two and six in the afternoon. At other times the patient was free from pain but she had a constant bearing down which prevented her from standing straight. Urination was distinctly affected. The output of urine was scanty and ceased altogether during the attacks. Toward evening she voided a larger quantity of urine either with a good deal of straining or on the contrary involuntarily and this seemed to terminate the attacks. The urine was never bloody.

As these symptoms pointed to an obstruction in the bladder Dr. Walter Fischel, who had observed the patient for a few days, referred her to me for cystoscopic examination on February 22, 1916. The urine was clear the quality normal. The cystoscope on its passage through the urethra encountered an obstacle and had to be introduced steeply upward. The capacity of the bladder was normal. The appearance of the vesical mucosa was also normal with the exception of large pulsating vessels. There was a tumor in the vesico vaginal septum which pushed the bladder wall forward. The ureteral openings were on the top of the eminence.

Gynecologic examination showed the following. Vulva and vagina were senile. The finger was arrested about three fourths inch above the en-

trance by a round tumor behind the anterior vaginal wall. Its relation to the cervix could not be ascertained because of a constriction which did not even permit the tip of the index finger to pass. The anus was wide open and by rectovaginal examination a smooth firm tumor about the size and shape of an ostrich egg which filled the entire pelvic cavity could be felt. The upper pole could not be mapped out through the adipose abdominal walls and the marked tenderness forbade more accurate exploration.

A tentative diagnosis of cervical fibroid was made although the absence of bleeding rendered this assumption highly doubtful. At any rate there was a vital indication for operation as the intense pain and the evident obstruction to urination made surgical intervention imperative despite the advanced age of the patient. Accordingly operation was performed February 25, 1916. In spinal anesthesia which took effect within ten minutes after the injection the abdomen was opened in the median line by an incision from the symphysis to within two fingers breadth of the umbilicus. There were no adhesions or fluid in the peritoneal cavity. The intestines and omentum rested upon the upper pole of a tumor which extended above the promontory. With the patient in deep Trendelenburg position and the intestines pushed out of the way the tumor was exposed to view and seen to rise from the pelvic cavity. It was the enlarged and fluctuating body of the uterus which was in continuity with a very much larger and markedly fluctuating cervix. The round ligaments inserted at their normal places. The left tube, adherent to the uterus represented a tortuous hæmatosalpinx; the left ovary was atrophic. The right tube was also adherent and distended though to a lesser degree the right ovary probably atrophic could not be identified. The fundus and upper portion of the rectum were kept in apposition by a broad and thick sheet of adhesions which was clamped and severed.

The diagnosis of hæmatometra had by now become obvious, and panhysterectomy was carried out in the usual fashion with preventive ligation of all arteries. Volsella were not used in order not to tear into the uterine cavity. After the round and infundibulopelvic ligaments on either side had been cut a flap of peritoneum was dissected off from the posterior aspect of the cervical tumor. The bladder was pushed off from the anterior surface almost down to the urethra and also laterally. The over stretched cord like uterine arteries could be plainly seen and were ligated separately. It was now an easy matter to free the lower portion of the tumor by



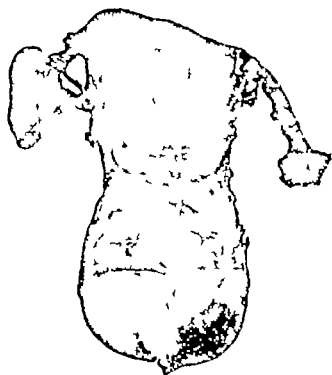


Fig. 1. Posterior aspect of the tumor. A hand-like indentation indicates the border between cervix and body of the uterus. Note the course of the uterine artery on the right and the distention of both tubes.

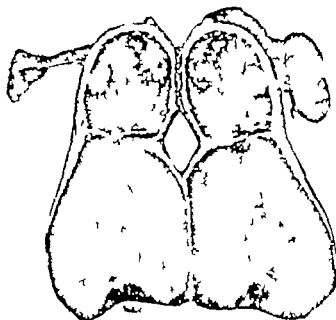


Fig. 2. Tumor opened by median incision. The upper and smaller portion is the uterine cavity; the lower and larger one represents the cervical canal and the distended vagina. The two parts are separated by a thick bridge of fibrous tissue in which a small central opening indicates the internal os. The entire tumor is filled with blood. Note the development of adenocarcinomatous masses in the uterine cavity.

admitted the tip of the index finger while the uterine body formed a movable round smooth and fluctuating tumor of the size of a man's fist. On operation 60 cubic centimeters of blood was drained from the uterine cavity. The source of the blood and the cause of obstruction was a carcinoma within the cervical canal  $2\frac{1}{2}$  centimeters above the external os and extending upward to the internal orifice. That cancer of the cervical canal may obstruct the passage and lead to retention of fluid in the uterine cavity is well known to every gynecologist. In almost all such cases however the result is a pyometra. To cite but one of the many cases reported, Hanseemann found at autopsy in a woman of 72 the uterine body transformed into a thin walled sac the size of a child's head which was filled with pus; the cause of the occlusion was a beginning cancer in the cervical canal. It is more than likely that in such cases of pyometra the contents of the uterine cavity had at first been sanguinolent and only secondarily become purulent by the invasion of bacteria from the necrotic new growth. In Chrobak's case a woman of 55 whose menopause dated 8 years back presented herself with a carcinoma of the vaginal portion which was thoroughly excochleated and cauterized with pure nitric acid. This cauterization caused atresia which in its turn led within 3 $\frac{1}{2}$  years to the formation of hydrometra. The uterus corresponded in size to one of four months' pregnancy and on puncture 350 cubic centimeters of a yellowish greenish cloudy alkaline fluid with a spe-

cific gravity of 1026 were drained. Microscopically, the fluid contained red blood corpuscles epithelial cells and cholesterol crystals. Five months later an even larger hydrometra had formed.

In Frank's observation of postclimacteric hamatometra the etiology of atresia was likewise due to excessive cauterization. A woman of 49 had been subjected to some form of intra uterine treatment ten years previously. Menses had ceased since then. Menstrual menses occurred until one year ago and again for the last six months. On laparotomy there was a hematosalpinx on the left side, the size of a fist; the uterine body was enlarged and contained dark liquid blood. Lichtenstein's patient was a woman of 51 in whom menopause had occurred  $\frac{1}{2}$  year ago. Pelvis and lower abdomen were occupied by a smooth cystic tumor extending almost to the umbilicus. The vaginal portion was not discernible. A very small reddened round area in the roof of the vagina indicated the site of the external os. A sound forced through at this point entered into a large cavity from which 500 cubic centimeters of dark thick partly clotted blood escaped. The atresia in this case was due to senile conglutination of the external orifice.

While these two observations strictly speaking do not belong to the category of postclimacteric hamatometra, the last named case leads us to the most frequent cause of



gynæstria in advanced age namely senile adhesive processes in the genital tract. The familiar prototype of these affections the so called senile vaginitis is a misnomer. There is no inflammation at work as the term would indicate. The multiple squamous epithelium of the vagina becomes thinner in old age even as the epidermis does. The superficial layers become hornified and are cast off and the basal layer loses to a large extent its reproductive faculty. The connective tissue papillæ with their central blood vessels now become visible through the thinned transparent mucosa and even bared in place. Hence the dot like reddening of the vagina. A thin colorless sticky and acid fluid often with traces of blood exudes from the exposed capillaries. Neighboring parts of the vagina are thus rendered raw and may easily conglutinate. Moreover age changes take place in the elastic tissue of the vaginal wall. The delicate wavy elastic fibers which are present in large quantities in the vaginal wall become thick straight unyielding broken off in places. Thereby more or less complete annular constrictions occur in the wall the lumen of the vaginal tube is narrowed opposing parts are brought into constant apposition and readily conglutinate to one another. These connections may in course of time become very firm and constitute dense bridges bands or membranes which eventually may completely occlude the vagina as anybody has noticed who has had occasion to examine very old women. Veit has emphasized that the favorite site for this chronic adhesive vaginitis is the border between the middle and upper third of the vagina because the levator muscles are attached to the vagina at this point and narrow the vagina even more by their contractions. In the upper third of the vagina the vaginal portion is too bulky and prevents apposition of the mucous surfaces while in the lower third the secretions as a rule are too copious to permit an undisturbed coalescence.

Though these conglutinations are quite common if not physiological yet they hardly ever cause any disturbances because the parts above the atresia remain in a state of senile inactivity. Only very exceptionally

has an accumulation of fluid been found above the occlusion as in Veit's two cases of hemmatocolpos in one of which a cervical polypus was the source of the bleeding.

In a case of hemmatometra in a woman of 70 Fere found at autopsy a senile atresia in the vagina while the blood retained in the uterine cavity seemed to have owed its origin to a severe mitral lesion. In the hemmatometra observed by Gradchnigg in a woman of 83 the source of bleeding is not stated nor does S. Wedge offer any explanation as to the origin of bleeding in his case of hemmatometra in a woman of 66.

The observation recorded by Steiner furnishes more complete data. In a woman of 66 whose menopause dated 20 years back the uterine body at operation was found transformed into a thin walled sac containing about 500 cubic centimeters of chocolate colored blood. The walls of the sac were normal but the cervix was the site of an adenocarcinoma. The author assumes that this had caused hemorrhages which the senile shrinking and atresia of the cervix had prevented from escaping.

Even more instructive is the case reported by Sondheimer concerning a woman of 60 who had had one confinement thirty years previously and had been in the menopause for about seventeen years. She had noticed a hardening in the lower abdomen for about six weeks associated of late with slight pain. Abdominal palpation revealed a fluctuating tumor which corresponded in size and shape to a pregnant uterus of five to six months. Just above the symphysis the tumor showed a sort of constriction but seemed to broaden out in the pelvic cavity. Vaginal examination was impossible because of a complete atresia at the vaginal entrance. By rectal examination on the upper half of the pelvic cavity was felt with a fluctuating tumor obviously the continuation of the mass felt above. Differential diagnosis was between an ovarian or renal cyst and a hydro or hematomatometra. In narcosis an attempt was made to remove the atresia. The vaginal walls could be pushed apart by the finger for a distance of about three centimeters. As the density of the conglutination prevented further progress puncture was made by which a cloudy brownish red thin fluid was obtained which contained fresh and degenerated erythrocytes degenerated leucocytes and other fatty detritus and many large oval round and cylindrical cells with large glistening nuclei and fatty protoplasm. Laparotomy as done a few days later. The tumor as found to be the enlarged and distended uterus. Both ducts were enveloped in old adhesions. On puncture of the uterus a fluid similar to that obtained through the vagina escaped. The uterus was opened and more than three quarts of fluid were emptied. Numerous small and larger particles of a medullary substance were mixed in the fluid. The inner surface of the uterine cavity was covered with soft tumor masses the largest being of the size of hen

egg. The finger could be passed downward through a rigid isthmus several centimeters in length into a wide cavity filled with the same bloody fluid and loose tumor particles. The isthmus was the cervix, the cavity below the distended vagina. The only metastasis was a nodule of the size of a hazelnut in the right tube near the uterus. The uterus was amputated, but the patient died ten days after the operation. Microscopic examination revealed adenocarcinoma which had not yet invaded the myometrium.

There are several interesting parallels between Sondheimer's case and mine. Both patients were aged women of 67 and 74 years respectively. In both the vagina was occluded by senile atresia keeping the blood dammed up which in both instances originated from an adenocarcinoma of the body of the uterus. The new growth in both cases projected into the uterine cavity but did not invade the myometrium. The only visible metastasis in Sondheimer's case was in the tube. In my own case the greyish spots in the sigmoid noted during the operation though not suspected at the time very likely represent a metastasis.

Aside from these points of similarity the present observation shows a much greater intensity of the hydrostatic pressure on the part of the accumulated blood. In Sondheimer's case the fluid dilated the most easily yielding portions of the genital tract: the uterine cavity and the vagina while the rigid cervix resisted distention. In my case, the cervix as such had ceased to exist. Only the fibrous ring of the internal os had preserved its integrity (Fig. 2). Below it the cervical canal blended with the distended vagina and formed one large cavity in which only the increasing thinness of the walls may give an indication of the old landmarks.

The vaginal atresia had in the course of years become so thoroughly organized as to form a solid floor which was separated from the closed roof of the vagina by loose connective tissue. This explains the ease with which the tumor could be shelled out without the severance of any connection with the vagina. The study of the literature collected above proves this observation to be unique.

At some time during the process blood was dammed back into the tubes which quickly

became sealed at their outer ends. The formation of hematosalpinx in this case is an additional proof of the contention of some writers (Frankl) that occlusion of the tube need not always be the result of inflammation.

It is impossible to say how long the cancer has existed in this case. The size of the tumor masses and the absence of myometrial involvement permit the assumption that the growth was still in a fairly early stage. Mechanical pressure of the collected blood had not interfered with the development of the tumor. Incidentally the amount of bleeding from a cancer of the uterine body is well shown in this case.

A word about the operative technique may not be amiss. Thanks to the spinal anesthesia employed the immediate risk of an operation of such magnitude in a very old patient was greatly reduced. In the removal of the large tumor the usual technique of hysterectomy by means of clamping and cutting the parametria would have been impossible without injury to the ureters. The writer has for years been in the habit in his hysterectomies of ligating the uterine arteries separately before severing the parametria and the successful performance of the operation in the present case is directly attributable to this technique. Convalescence was ideal in every respect, and there was every reason to anticipate a permanent success. No clinical symptoms indicated a thrombosis of the pelvic veins and the fatal embolism which occurred 15 days after the hysterectomy must be considered as one of those unavoidable accidents which at times mar our most successful operations.

#### SUMMARY

In a woman of 74 who had menstruated normally until 35 years previously severe pain pointing to obstruction of the urinary flow led to the detection of a large fluctuating tumor which filled the entire pelvis and extended upward almost to the umbilicus. The vagina was occluded by senile atresia. Laparotomy in spinal anesthesia revealed the tumor to be an enormous hæmatometra and hæmatocolpos with bilateral hæmato-

salpint. Pnhysterectomy was performed successfully and the tumor which was connected with the vagina only by loose connective tissue was removed unopened out of its bed. Convalescence was undisturbed the patient left the bed on the twelfth day after operation but succumbed to an embolism on the fifteenth day. The cause of bleeding into the occluded genital tract was an adeno carcinoma of the body of the uterus.

Accumulation and retention of blood in the genitals of women past the menopause is very rare and the few reports existing in literature are reviewed in the foregoing. Only one case has been recorded which is similar to the one presented above. Considering how ever the extreme old age of the patient the extent of retention of blood the anatomic

condition of the lower pole of the tumor and the modus operandi the present observation occupies a unique position in literature.

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A STUDY OF THE ANATOMY PATHOLOGY AND TREATMENT OF  
UTERINE PROLAPSE RECTOCELE AND CYSTOCELE

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I. INTRODUCTORY

FOR many years the writer has been puzzled by two questions arising in connection with vaginal plastic work. The first is why even in the most skillful hands are the results of repair so uneven? The second why is it impossible to teach the average house surgeon the principles of plastic repair during his term of service although it is easy to inculcate the technique of other type operations such as herniotomy hysterectomy etc?

The present paper was written in the hope of helping to answer these two queries satisfactorily in other words to assist in obtaining more uniform results on the one hand and of describing a simple anatomic basis for operative work on the other.

The successful treatment of the varied conditions arising in plastic surgery requires first the proper selection of the operative procedures second a technique sufficiently elastic to be applicable to quite diverse

anatomical changes otherwise the demands made upon the judgment and skill of the operator become so great that this proficiency can be acquired only after many years of practice and at the expense of many and repeated failures.

The writer has seen individual operators who through long years of experience or by reason of special gifts and dexterity have acquired the necessary skill but who were quite unable to teach to the spectator or even transmit to their regular assistants the method by which they obtained their good results. This inability to teach is due to the fact that these operators although by nicety of judgment by precision of execution by unconscious visualizing of reconstruction and by proper extent of denudation they obtained good results did not expose the field anatomically and did not perform an anatomical repair such as is done as a matter of course in inguinal herniotomy for example.

During the past few years concerted efforts

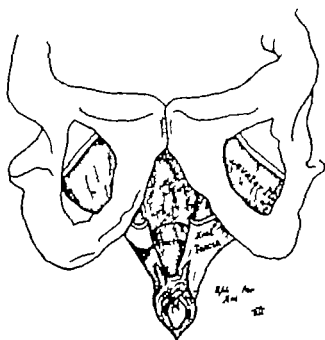


Fig. 1 Nulliparous outlet showing the two levators ani approaching toward the rectum the levator gap the rounded edge of each muscle and the fascial junction. The lower or outer fascia is called anal fascia the inner fascia (only its edge is seen) is known as the levator fascia. The external sphincter ani appears.

NOTE: Figs. 1 to 9 inclusive were drawn from clay models fashioned from sketches of dissections on the cadaver. The dissociable models very graphically illustrate the anatomy of the perineal region and of prolapse.

have been made to devise a true anatomical repair in perineal lacerations by suture of the levator ani. The range of applicability and the merits and demerits of this operation will be discussed in succeeding paragraphs.

For a number of years also the so called "interposition" operation has been employed in the treatment of cystocele. This procedure is anatomical in so far as its execution is concerned but the resulting repair distorts natural conditions to a degree which necessitates sterilization if performed in the child bearing period. The writer considers the operation unsatisfactory when applied to cases of prolapse.

With these exceptions, the majority of operations devised for cystocele and rectocele depend upon ingenious denudations complicated application of sutures etc rather than upon a firm anatomical basis.

The object of this paper is to formulate methods for the repair of cystocele and rectocele, applicable to varied conditions and

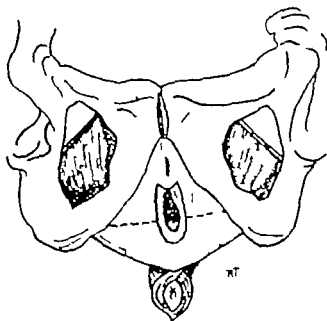


Fig. 2 The triangular ligament has been inserted between the pubic rami. The ligament is pierced by urethra and vagina. Below it affords attachment to the sphincter.

giving more uniform results in the hands of operators of only average skill and experience.

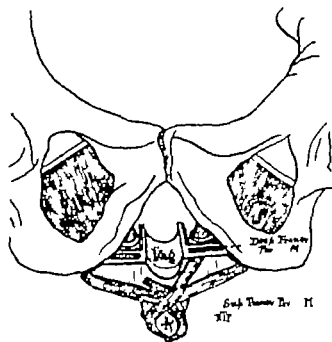


Fig. 3 The triangular ligament has been cut across the dotted line shown in Fig. 2 in order to demonstrate the junction of five fascial planes. From without inward — superficial layer of triangular ligament deep transverse perineus muscle deep layer of triangular ligament junction of anal and levator ani fascia (rounded edge) fascia vaginae propria. The muscles superficial to the triangular ligament are also shown — superficial transverse perineus, constrictor cervicis.

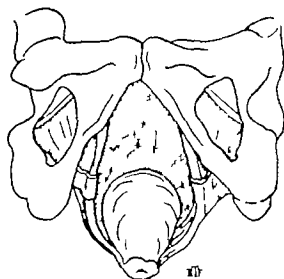


Fig. 4. Multiparous outlet. The side levator gap due to stretching and tearing of the levator muscle and fascia is shown, also the bulging rectum (tear of fasc. recti propria).

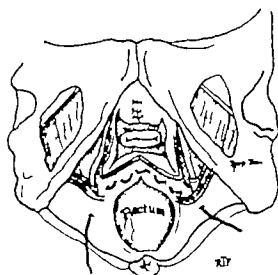


Fig. 5. The stretched triangular ligament is also shown with a median tear through which the rectum bulges. A deep suture has been passed taking in the five fasciae illustrated in Fig. 3. The cervix and deeper part of the vagina is indicated.

ence. This implies knowledge of the regional anatomy and standardization of technique rather than the invention of new procedures.

The experience upon which the observations to be detailed are mainly based was acquired in the wards of Mt. Sinai Hospital during the past ten years. The writer takes pleasure in acknowledging his obligation to Dr. Joseph Brettaner, the head of the first gynecological service, both for inducing him into the mysteries of plastic surgery and for the use of the material. During these 10 years more than 850 plastic operations were performed by the attending and house staff, but only in the past few years has the writer personally felt a fair degree of confidence in his method of repair. This greater uniformity of results depends not upon a gradually acquired increase in proficiency but rather upon successful standardization of successive steps based upon anatomical foundation, so that today the method of repair is applicable to greatly varied conditions. It is with the hope that at least some of this laboriously acquired experience can be handed down to colleagues who have had less opportunity in perfecting themselves in this important

branch of gynecology that this paper is written. Acknowledgment is also due to Professor Huntington of the College of Physicians and Surgeons for his kindness in supplying anatomical material.

## 2. ANATOMY

Much has been written about the anatomy of prolapse and of the mechanism which keeps the uterus in place. The essential facts few and readily understood have too frequently been obscured by complicated description and ponderous classifications.

The bony pelvis is defective. It is converted into a bowl shaped cavity by ligaments, muscles and fasciae.

### (A) LOWER OR SUPPORTING APPARATUS

A thin muscle sheet, the levator ani and coccygeus covered upon their upper and lower surfaces by fasciae form the true pelvic diaphragm. Anteriorly in the region of the pubic arch the diaphragm is defective as the two levators do not approach to within 3 to 4 centimeters of each other (Fig. 1).

The resulting long but narrow gap is partly closed by the accessory pelvic diaphragm or

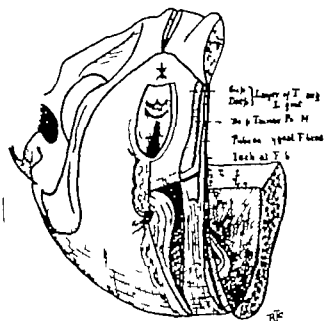


Fig 6 Anterior and lateral view of muscles and fasciae. The relation of the sphincter ani to triangular ligament and coccyx are shown. The various parts of the levator muscle appear—pubococcygeal sling between it and the sphincter are shown the puborectal portion and running transversely to the pubococcygeal fibers. The ischial part can be distinguished.

triangular ligament a thin but strong structure composed of two fascial layers enclosing the deep transversus perineal muscle. The triangular ligament ends about midway between fourchette and anus in the center of the perineal body (Fig 2).

1 The *levator ani* on each side of the pelvis arises from the posterior surface of the pubic bone and from the fascia covering the obturator internus as far back as the spine of the ischium. Some of the pubic fibers sweep alongside the lateral vaginal wall and insert into the anterior and lateral rectal wall mingling with the sphincter ani—puborectal fibers (Figs 6 and 7). Other fibers taking a more lateral course insert on the apex and sides of the coccyx—pubococcygeal (Fig 7). The remaining fibers arising from the obturator fascia and ischium insert in a median raphe behind the rectum extending to the apex of the coccyx (Fig 6).

Fasciae of the levator ani. The superior or pelvic surface of the levator ani is covered by a thin firm fascia (*levator ani fascia*) continuous posteriorly with the fascia covering

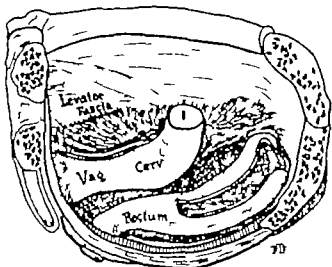


Fig 7 Extramedian sagittal section through the pelvis passing to left of the cervical canal. From before backward and above downward appear descending ramus of pubis ascending ramus of ischium and triangular ligament all in cross section next the pubococcygeal fibers of the levator ani the sphincter of the anus and the ischial portion of the levator. In the pelvis are shown the iliopectineal line iliac fascia white line levator ani fascia pelvic connective tissue uterine artery and ureter pubococcygeal fascia vagina and cervix perineal body rectum (partly cut open) posteriorly sacrum cut across. In front of the cut ureter is seen the urethra (bladder has been removed).

the coccygeus and pyramidalis above with the iliac fascia (Figs 7 and 8).

The lower (perineal) surface of the levator ani is covered by the anal fascia which bounds the mesial aspect of the ischioanal fossa (Fig 1).

Along the free mesial border of each levator muscle (the muscles as previously stated do not come together but leave a long narrow hiatus) the two fasciae—levator or superior anal or perineal—coalesce forming a rounded edge (Fig 1). In the undissected state neither this edge nor the levator gap are visible from within the pelvis when viewed from above because the accessory diaphragm or triangular ligament next to be described bridges most of the levator gap and fuses with the fascial edge just mentioned (Fig 8).

3 The accessory pelvic diaphragm or *triangular ligament* fills in the space beneath the pubic arch nearly as far back as the tuber ischii (Fig 2). It is composed of a thin sheet like muscle the deep transverse perineus enclosed between two thin but firm fascial

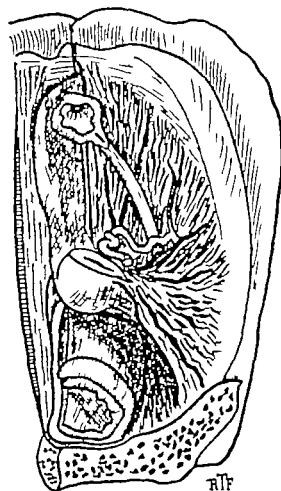


Fig. 8. Same model viewed from above. On the left side all tissue has been removed so as to expose the pubo-coccygeal fibers of the levator muscle. Toward the medial line is the vagina and cervix. In the medial line are seen urethra, ureteral opening and ureter, cervix, cut across, and rectum. The right half of the pelvis only, the peritoneum has been removed. The terine artery crosses the ureter after superior calyx. The ligament has been pulled off. A vaginal branch descends on the pubocervical ligament. The connective tissue forming cardinal and sacro-termental ligaments are shown.

layers—the superior and inferior layer of the triangular ligament (Fig. 3). The free border of the transversus perinei profundus extends from the tuber ischi to the centrum perineale. The superior and inferior layers of the triangular ligament here coalesce so as to enclose the lower border of the muscle (Fig. 6). The triangular ligament obtains firm fixation by means of its attachment to

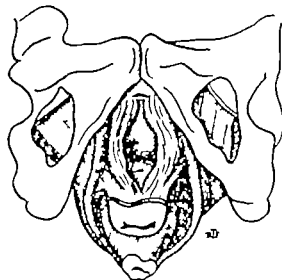


Fig. 9. Anatomy of cystocele. The cervix has been pulled down, the vaginal mucosa duly removed. The bladder pillars are shown in continuity with the cardinal ligaments.

the bone. The ligament is pierced by the urethra and vagina, thus affording support and fixation to these canals with the fasciae of which it blends.

4. The meeting place of levator and anal fasciae forming the rounded fascial edge bounding the levator gap has been mentioned. Neither the gap nor the edge become apparent because the superior layer of the triangular ligament blends with this junction point. Five fasciae meeting along this line, where the pelvic outlet is pierced by the vagina, levator, anal, superior and inferior layer of triangular ligament, and the fascia of the vagina (Fig. 3).

5. The rectum and anus pierce the pelvic diaphragm behind the triangular ligament. The sphincter ani unites with the posterior edge of this ligament at the centrum perineale. At a higher (deeper) level the puborectal fibers of the levator insert into the anterior and lateral rectal wall. More posteriorly the levators unite in a median raphe behind (i.e. superficial to) the rectum (Figs. 6 and 7).

6. Viewed from within the pelvis may thus be considered a cavity completely closed below, the diaphragm being pierced by the urethra, vagina and rectum. Each of these tubes is invested by a thin but firm fascia



Fig 10 Photograph of a cadaver dissection. The bladder has been removed and sutures passed as advised by Polk. Complete repair is possible only from below as the fixed portion of the bladder (here removed) interferes

propria as it passes through the triangular ligament or levator fascia. This fascia propria extends both upward and downward along each tube. The levator gap or hiatus in the normal pelvis is merely a potential gap or weak spot (Figs 7 and 8)

#### (b) UPPER OR HOLDING APPARATUS

Both for the sake of simplicity and because it corresponds most closely to conditions found at operation all fascial structures encountered within the pelvic (levator coccygeus pyramidalis) fascia will be considered as connective tissue. Anatomists have described bands ligaments and aponeurotic sheets and fasciae in confusing profusion depending largely upon the state of preservation of the cadaver the method of fixation used etc. The description here employed corresponds most nearly to that given by Poirier and Churpey (1)

The subperitoneal space (i.e. the space between the peritoneum and the levator fascia) is partly filled by the urethra and base of the bladder the vagina and uterocervical area and the rectum. Blood vessels nerves lymphatics and ureters also traverse this space. All interstices are filled in by con-



Fig 11 Photograph of cadaver dissection. Interocoele seen from within. Uterus pulled over symphysis. In Douglas cul de sac is a hernial orifice (through which the enterocoele finds its way). To the left the peritoneum has been opened in order to trace the course of the hernia down to the perineal body.

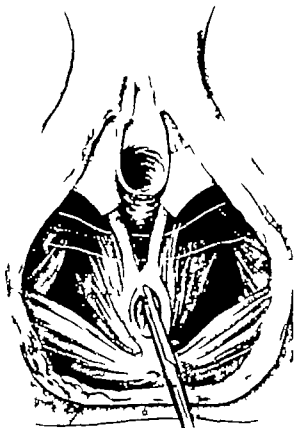
nective tissue of different consistence varying from loose fatty areolar tissue to well defined fibromuscular and elastic bands. This tissue encloses and fixes the organs but yet allows them the freedom necessary to permit of various degrees of distention.

Three main divisions may be described all radiating from a common center the uterocervical junction to the pelvic wall.

1 *Pubocervical (pubo-escocervical) ligaments*. Extending from the posterior surface of the symphysis and pubic rami strong fibers run back to the cervix up to the level of the internal os on each side. These fibers blend with the fascia propria of both bladder and vagina near the median line laterally becoming continuous with the anterior portions of the cardinal ligament. At a distance of about  $\frac{3}{4}$  centimeter from the median line a vaginal branch of the uterine (Figs 7 and 8) runs downward in the pubocervical ligaments.

2 *Cardinal ligaments*. Numerous strong bands radiate laterally from the cervico-





The broad ligament is a double-layered structure that extends from the uterus to the lateral pelvic wall. It is divided into anterior and posterior layers. The posterior layer contains the uterine tubes and ovaries. The anterior layer is the main body of the broad ligament. It is shown here being incised to reveal the underlying structures.

uterine junction in a fan shaped fashion to each pelvic wall. At a lower level similar bands fix the lateral fornices and uppermost part of the vagina (paracolpium) at a higher level weaker bands form the lower part of the broad ligament (Fig 8).

3 The *sacro uterine ligaments* bands of very variable thickness and strength run from the posterolateral cryo uterine junction in a curved direction backward to the

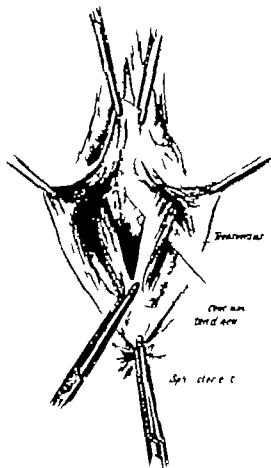


Fig. 3. The transverse peritoneal sac here ligated often taken for the levator ani. Isolated suture of the bundles of the sacral plexus from Doederlein and Kroenig.

sacro iliac joints. These bands form the lateral margins of Douglas cul de sac (Fig 8).

#### (C) PHYSIOLOGICAL IMPORTANCE OF THE SUPPORTING AND HOLDING APPARATUS

According to Hulbin and Tandler (3) all evidence is construed to signify that the muscles play the main or only role in maintaining the bladder uterus and rectum in position according to E. Martin (2) the fasciae are mainly responsible. The enormous and unwieldy literature can be referred to in these two monographs. To the unbiased observer both systems play important and co ordinate roles.

The holding apparatus (the subperitoneal

The broad ligament is a double-layered structure that extends from the uterus to the lateral pelvic wall. It is divided into anterior and posterior layers. The posterior layer contains the uterine tubes and ovaries. The anterior layer is the main body of the broad ligament. It is shown here being incised to reveal the underlying structures.

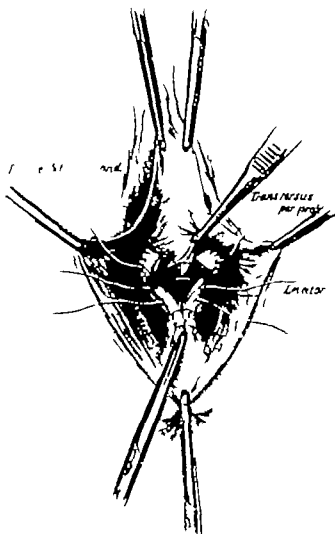


Fig. 13. To avoid the above error (Fig. 12) the authors advise cutting the transverse perineal and suture of the levator. This results in a complicated dissection and suture (From Doederlein and Kroenig).

connective tissue) may be compared to an elastic sling which maintains the uterus in labile equilibrium in the pelvis allowing descent in response to pressure from above and allowing lateral or anteroposterior excursions in response to pressure exerted by neighboring viscera. As soon as the pressure ceases the uterus is passively pulled back to its normal position.

The supporting apparatus (pelvic diaphragm) is a musculo-fascial plate which both reflexly and in response to the will by its contraction absorbs shocks due to increased intra-abdominal pressure. The tonicity of the diaphragm in addition gives continual support to the holding apparatus.

The holding apparatus may fitly be com-

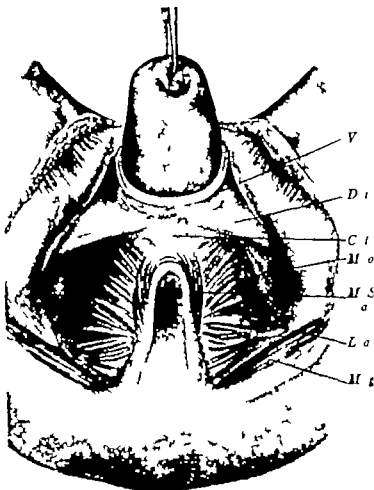


Fig. 15. This figure also is conditions in prolapse when the uterus is forcibly pulled downward. This puts the lax defective triangular ligament on the stretch. Compared with Fig. 16 the levators and fasciae are thin and weak (From Halban and Tandler — *Der Prolapsus*).

pared to the springs which continually maintain the burden and the supporting apparatus to the shock absorbers which ease exceptional stresses and strains.

From what has preceded it must be clear that no operation dependent upon the utilization of one system will be applicable to each and every case. A thorough understanding not only of the normal but also of the pathological anatomy is necessary in order to be able to cure the varieties of prolapse.

### 3. PATHOLOGICAL ANATOMY

**Prolapse.** In prolapse the holding apparatus (cardinal sacro-uterine pubocervical ligaments, etc.) has given way. In consequence, the uterus with the bladder and vaginal walls has descended through the levator hiatus which is usually broadened (7 to 10 centi-

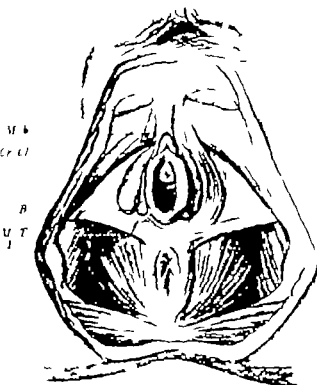


Fig. 1. Outline of bladder, not the bag of the triangular ligament. The regular anteroposterior position of the levator as compared with Fig. 1 (from J. Martin—Der H. (Leppel et al.))

meters instead of 3 to 4 (centimeters) (compare Figs. 1 and 4).

Shortening of the sacro uterine (Wertheim, Young, etc.) and of the round (Alexander operation, which merely improves the position by ante flexing) ligaments is in fact effective reeling of the cardinal ligaments is impossible. To overcome the descensus ventrofixation has been resorted to. Interposition may utilize the levator edges (Wertheim, 4) and vaginal hysterectomy seeks to shorten the sacro uterine and cardinal ligaments to which the vaginal vault is attached by overlapping the stumps (Goffe, Mayo, etc., 5).

**Cystocele.** The bladder normally is retained in position by a sling like fascial and connective tissue plate which is composed of anterior vaginal wall, pubovesicocervical ligaments and anterior part of the cardinal ligaments (Figs. 8 and 9). The fixed points are the posterior surface of the pubes and the

triangular ligament below and the anterior surface of the uterus at the level of the internal os above. During childbirth the fascial plate is torn and the movable part of the bladder (behind the ureteral orifices) gradually prolapses.

The weak spot can be repaired by utilizing the fascia propria of the vagina, the pubocervical and the anterior portion of the circular ligament (Fig. 9). Polk's operation 6 unites the upper part of the rent in the region of the cervix, but the fixed portion of the bladder prevents successful closure of the lower segment. This weak spot can be reached only from below (*vide infra*) (Fig. 10).

Interposition keeps up the bladder, but at the cost of grave anatomical derangement.

**Rectocele.** The rectum normally is held in place by a thin but firm fascia propria, an investment which it receives when passing through the levator fascia. In the lower third of its course the rectum and vagina are separated by the wedge shaped perineal body; above they are in close contact (Fig. 7). The levator ani inserts along the lateral and posterior surface of the rectum, except near the anus where the thin sling like mesial fibers (puborectal) after coursing along the sides of the vagina find their insertion in the anterior surface of the rectum, perineal body and sphincter ani (Figs. 6 and 7). The upper (pelvic) surface of the levator ani is covered by the levator fascia, the lower (ischio rectal) surface is covered by the anal fascia.

The levator and anal fasciae are closely connected with the lateral and posterior surface of the vagina and with the layers of the triangular ligament. At about 2.5 to 3 centimeters from the vulva these various fascial layers coalesce forming a very firm fixed support for the vagina (Fig. 3). Lateral tears of this region cause lacerations of the perineum, usually accompanied by rectocele, when the rectal fascia which may be considered the investment of the levator fascia given off as the vagina passes through this structure is also torn. At times only the rectal fascia is torn in which case a rectocele bulges downward over an intact perineum.

The upper portion of the vagina owes its

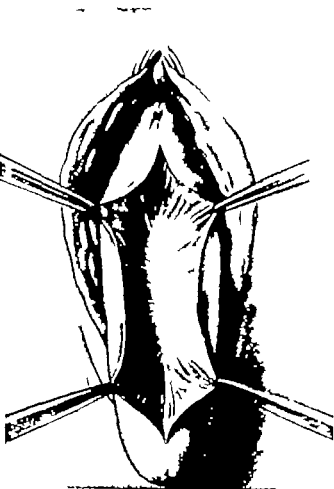


Fig. 1 Cystocele operation (1) Narrow denudation in order not to disturb fascial structures

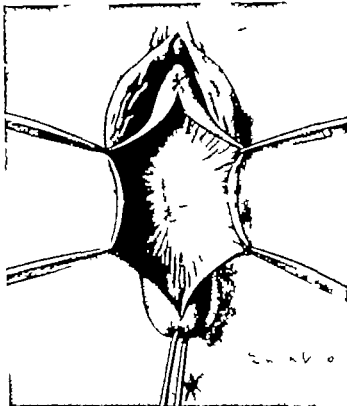


Fig. 18 Cystocele operation (2) Pushing back of bladder in median line blunt separation of vaginal flaps

support mainly to the uterus. If this organ descends the vagina invaginates and prolapses. If the thin but firm fascia covering the posterior vaginal wall (lowest part of Douglas cul de sac) is torn a hernial protrusion may descend through the gap and present in the rectovaginal septum or protrude from the vulva forming an enterocele (Fig. 11).

The upper portion of the rectum may form a similar protrusion if the rectal fascia is injured high up. The resulting protrusion is a high rectocele. It corresponds to a sliding hernia of other parts of the body (as for instance sliding hernia of the cecum).

To repair lacerations of the perineum and low rectocele reunion of the fascial meeting place previously referred to may be resorted to. Levator suture is illusory as the levator ani (puborectal portion) is a thin muscle slip not more than 2 to 3 millimeters in thickness

and of scant breadth. Often after these fibers are brought together in the median line the remainder of the muscle fails to be drawn together and lateral pockets or defects result. Quite frequently too the high perineum obtained after levator suture is inelastic and very tender producing severe dyspareunia. Finally the operation necessitates the invasion of the excessively fragile perirectal veins and consequently favors embolism. For these reasons many operators have abandoned levator suture after prolonged trial (Figs. 12, 13, 14, 15 and 16). Suture of the fasciae on the other hand not only approximates the muscles but unites five fascial layers (*vide ante* Figs. 3 and 5) on each side to those of the opposite side.

High rectocele and enterocele can be held back only by closing the upper hiatus. Description of the operation (*vide infra*) sufficiently explains the anatomical repair.

The middle portion of the vagina has neither fixed points nor is it in immediate contact with any fixed structures. Consequently only the rectal and vaginal fasciae can be utilized. If fixation is required re-

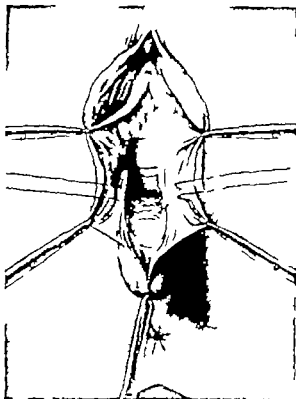


Fig. 19. Colpocleisis operation. Upper uterine segment held in place by sutures. Lower uterine segment held in place by sutures.

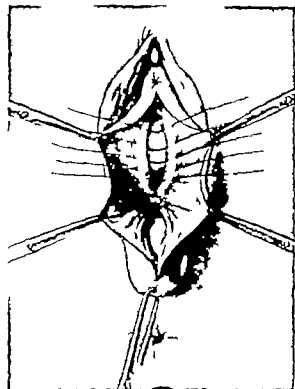


Fig. 20. Cervical operation. Cervical sutures held in place by sutures. Lower uterine segment held in place by sutures.

course must be held to the upper (sacro-uterine) or lower (triangular ligament) fixed point.

#### 4. SELECTION OF OPERATION

The operation to be chosen in a concrete case of relaxation or tear of the pelvic floor will depend not only upon the anatomical change noted but also upon the age, social condition and subjective complaints elicited. The ultimate result and both subjective and objective cure of the patient will depend almost as much upon the proper selection of the procedure as its operative execution.

**Age.** In a young woman who desires more offspring, extensive plastic operation should usually be refused or postponed until she has had a sufficient number of children. Measures if applicable may be employed palliatively in the interim. Only where deep cervical lacerations have caused miscarriages or where, as time passes, an increase of the changes are noted or severe disability

is complained of should operation be performed at once.

The preceding paragraph explains our attitude toward minor degrees of rectocele and cystocele and possible pregnancies. After enough children have been born sterility may be induced by ligation of the tubes.

Where the climacterium has been reached the factor of pregnancy plays no further role. In an old widow with severe prolapsus the vagina may be narrowed so as to leave a lumen merely sufficient for drainage (diameter of a fountain pen). Near the menopause the imminent involutionary changes must be taken into consideration (especially if vaginal interposition is contemplated as subsequent shrinkage in size of the uterus may defeat the aim and object of the operation).

**Lesions to be dealt with.** (a) *Cervical.* When repeated abortions occur and where syphilis or other constitutional causes can be excluded lacerations of the cervix should be

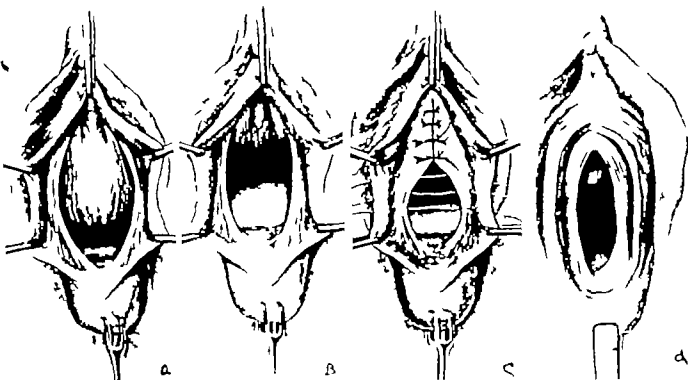


Fig. 21 Illustrating the steps of his repair of cystocele (From I. Martin — *Hastings* vol. 1)

treated by uni or bilateral trachelorrhaphy (Emmet's). Marked eversion ectropion hypertrophy, cervical hypersecretion may be relieved by low amputation (Schroeder's) in those cases in which symptoms develop. Usually amputation is only indicated in conjunction with operations for extensive prolapse when future pregnancy can be excluded. Trachelorrhaphy is always preferable to amputation in the childbearing period (7). For painful scars in the fornix excision of the scar in conjunction with trachelorrhaphy is indicated. High amputation flush with the vaginal vault is not a satisfactory procedure favoring sterility, dysmenorrhea and backache even when skillfully executed.

(b) *Rectocele and lacerated perineum* frequently annoy patients because of the resulting feeling of prolapse and weakness. Either alone or in conjunction with a lacerated cervix the lesion may be repaired even during the childbearing period if the perineum is not built up too high and the patient warned that the operation will *probably* be nullified by succeeding pregnancies. A rectocele can rarely be kept back by a pessary. When rectocele is complicated by enterocele (descent of Douglas' cul de sac) the condition is much

more difficult to cure. Such may occur alone or combined with prolapsus. The special technique required will be described later.

(c) *Cystocele* alone is rare, usually a rectocele is also present. Childbirth will in most instances produce recurrence after operation. Therefore temporizing is especially indicated unless sterility can be induced because secondary cystocele operations are notoriously difficult and unsatisfactory. A pessary will relieve bladder symptoms in those cases in which there is coincident either movable retroflexion or a prolapse<sup>1</sup>. Pessaries are less successful in holding back cystoceles proper.

In cystocele the type operation to be described is advised except in recurrent cases and in the few extreme cystoceles which are characterized by their globular shape and which have attained the size of a billiard ball. In these vaginal interposition is less unsatisfactory than other procedures if at the same time a high and long perineum is built up.

(d) *Retroversion or retroflexion* when combined with either relaxation or tears of the pelvic floor require interference because they form the first stage of prolapse. Early cor-

<sup>1</sup> Determine whether the bladder symptoms are due to the uterine malposition, *easy*. If pessary corrects both the displacement and the dynamic, separate correction is indicated.



Fig. 1. The incision is made deep horizontally. The triangular ligament has been passed from the patient's left. It first took in the triangular ligament, then the fascial rectum, and the anal structures on the right side. See Fig. 5.

resection is therefore indicated. In the child-bearing period movable malpositions may often be corrected by the use of the pessary unless the perineum is deeply torn. In later life if symptoms are complained of or the condition shows a tendency to increase operation is advisable.

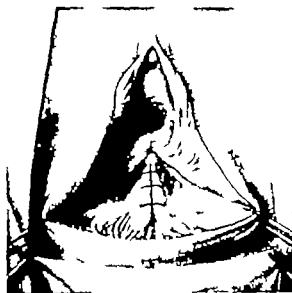


Fig. 2. The sutures have been tied. Only the superficial perineal body and the skin perineum remain to be repaired.

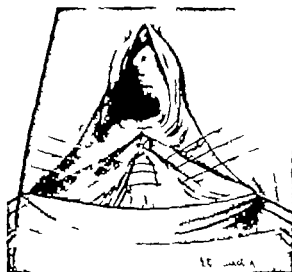


Fig. 3. Rectocele operation. (1) The perineal incision has been tied holding back and holding the rectum and drawing the triangular ligament. Three additional sutures are placed below the triangular ligament and the anal edge.

Adherent retroversion or retroflexion combined with vaginal relaxation or tears of the pelvic floor usually requires interference because of pain and backache.

The operations of choice during the child-bearing period for movable retroflexion are anterior and posterior colporrhaphy combined with the Alexander operation. If adhesions are present a laparotomy should precede the shortening of the round ligaments (*vide infra*). If no more children are wanted ligation of the tubes and ventrofixation may be employed to correct both movable and adherent malpositions.

An enormous number of operations have been devised and recommended to treat retroversion and flexion. Doubtless some of them have special advantages. The writer has found the Alexander Adams and ventrofixation sufficient and satisfactory if properly selected.

(c) *Prolapse*. As prolapse of the uterus has a marked tendency to increase and produce progressive atrophy of the fascial structures, edema and hypertrophy of the cervix, decubital ulcerations, etc., it is unwise to procrastinate except in such very rare instances in which future pregnancies are ur-

gently desired or where the physical condition of the patient (extreme age pulmonary cardiac, renal or other disease) contra indicates interference. Various pessaries such as the Meyer Schatz or even McIntosh may be employed palliatively in these cases.

If more children are wanted anterior and posterior colporrhaphy and a tight Alexander may be performed. This operation is uncertain in its results under the given conditions but it will at least greatly improve the prolapse and may even successfully withstand the test of repeated labors. Ventrofixation far down on the anterior surface of the uterus may not produce either miscarriage (third or fourth month) or dystocia at term. Usually this operation is inadvisable because of the likelihood of dystocia. The type operation is amputation of the cervix, anterior and posterior colporrhaphy ligation of the tubes when necessary (age) and ventrofixation. Vaginal interposition though highly recommended by some does not appeal to the writer in prolapse. Where the condition of the patient is poor vaginal hysterectomy with sewing together of the stumps and high perineorrhaphy is a shorter and fairly satisfactory operation if the vagina is greatly narrowed. If recurrence takes place after either this operation or vaginal interposition it is very difficult to improve the resulting disability by any operative procedure less radical than complete obliteration of the vagina.

(f) *Complete tears of the perineum* should be repaired as early as three to four months after labor because of the social disability resulting from incontinence. The Tait flap splitting operation with separate suture of the sphincter an is very satisfactory.

(g) *Accessory troubles*. Occasionally vesico vaginal or rectovaginal fistulae require repair. The subject does not fall into the frame of this discussion. Slight incontinence of urine often complained of with cystocele, may be overcome by suturing the muscle fibers at the neck of the bladder and the torn fascia (triangular ligament) when the cystocele is repaired.

Cysts of the vagina removal of hemorrhoids vaginal myomectomies vaginal liga-

tion of the tubes etc may be performed during the course of vaginal repair. During laparotomy appendectomies myomectomies removal of cysts and of diseased adnexa and even hysterectomies can be done. Umbilical or ventral hernia may require closure. During the course of an Alexander's operation inguinal or even femoral hernia are readily dealt with.

## 5 PREPARATION ANÆSTHESIA SUTURE MATERIAL, DRAINAGE

(a) *Preparation*. Before undertaking a plastic operation local infections such as furuncles eczema or dermatitis must be cured by cleanliness rest, applications of salves and cleansing douches (saline). Edema of the cervix and decubital ulcers due to prolapse require no treatment except bed rest, continued for days or weeks. Cystitis should be cured before operating. General conditions such as diabetes bronchitis etc should be improved by medical measures.

Before operation the vulva anal region and, if laparotomy is contemplated the mons and abdomen should be shaved. A dose of castor oil (1 ounce) given the night before operation followed by a low enema in the morning is sufficient preparation for the intestinal tract. One half hour before inducing anæsthesia morphine gr 1/6 and atropine gr 1/150 by hypodermic may be given in order to quiet the patient and lessen the amount of anæsthetic.

(b) *Choice of anæsthetic*. As a routine the gas ether combination has been employed in our work. For special indications chloroform (emphysema) or gas and oxygen (nephritis tuberculosis) are used. In isolated instances local anæsthesia — alypin 2 per cent Eucalan 1 per cent — have been used for rectocele operations — tolerant patients complain of little discomfort except when the deeper sutures are drawn together.<sup>1</sup> Tracheorrhaphy may be done without anæsthetization.

(c) *Suture material*. For all buried sutures 10-day chromic catgut is employed. When

<sup>1</sup> Under local anæsthesia the involuntary reflexes of the patient makes full and satisfactory exposure difficult so rectocele operation in the writer's hands the results have been less satisfactory than under general anæsthesia.



placed very close to bladder or rectum only fine sizes should be used as coarse gut may wander into the bladder or become infected by the proximity of the rectum. The cervix has been found extremely tolerant to thick twisted silk which remains *in situ* for 4 to 8 weeks without producing irritation and consequently reduces post operative cervical hemorrhage to a minimum. The vaginal mucosa has usually been sutured by us with interrupted silk of medium caliber. In extensive plastics thin chromic gut may be substituted to avoid the inconvenience of removing inaccessible sutures later. Silk has been invariably used for the skin perineum. The perineal stitches may be removed any time after the sixth day if they show evidence of cutting through.

(d) *Drainage* After curettage trachelorhaphy or amputation of the cervix a piece of iodoform gauze (5 per cent) 1 to 1 1/2 inches wide has been carried up to the fundus and not removed until the fourth morning after operation. A piece of iodoform gauze sufficient in size to exert pressure on both anterior and posterior vaginal walls is inserted into the vagina at the end of the vaginal operations and removed at the same time as the cervical drain. The pressure exerted by the gauze reduces the amount of oozing.

If undue hemorrhage is encountered during a cystocele operation (very rare) or lunn, interposition a small piece of iodoform wick may be led to the base of the bladder (or fundus uteri) between two adjacent muscular membrane sutures. A silk ligature attached to the wick and led out of the vagina facilitates its withdrawal (on the second day).

## 6 POSTOPERATIVE TREATMENT

Sufficient morphine to insure moderate comfort should be given. Great depression of respiration or extreme scantiness of urine are contra indications to the continued exhibition of the drug. As soon as the morphine can be stopped deodorized tincture of opium grt 1/2 bid are given to constipate the bowels until the third night. On the fourth morning a saline purge is given. Two hours

If sudden high post operative rise of temperature occurs has been our custom to remove the gauze at 1 hour and on of uterine secretions occur only through the stay comes th

later a low enema incites the bowel to evacuation.

Patients are allowed to urinate spontaneously. If retention is noted they are catheterized every 8 hours (except patients with extensive cystoceles Alexander's operations or ventrofixations who are catheterized every 3 hours for the first three days to avoid over distention of the bladder). After each micturition the vulva is irrigated with sterile water or weak bichloride of mercury solution (1 to 1000) and covered with a dry sterile pad. Patients with complete tears of the perineum are kept constipated for 5 to 7 days. Castor oil is given to move the bowels and an oil injection through a small catheter is given to soften the fecal column.

During the period of constipation patients receive fluids (except milk) after the bowels have been moved soft and then full diet.

Douches need only be given if there is profuse foul discharge (sloughing discharging hematoma).

## 7 OPERATIVE TECHNIQUE

### A CURETTAGE

Is always performed on every patient who has not passed the menopause. If signs of pregnancy (chorion) are found no plastic should be done until involution is complete (3 months) as the danger of infection of thrombosis and embolism is great and operative bleeding is regularly excessive. Curettings suspicious of carcinoma likewise require postponement of plastic operations until a microscopical examination has been made.

### B TRACHELORHAPHY (LACERATION)

Emmet's classical procedure is satisfactory. In the childbearing period the denudations should be narrow. Silk through and through sutures not entering the cervical canal are used.

### C AMPUTATION OF THE CERVIX

(Erosio hypertrophy chronic endocervicitis) Schroeder's method of lateral incision followed by wedge shaped excision of anterior and posterior lips suffices. It is unnecessary to amputate at a high level as hypertrophy diminishes markedly after operation due to the circulatory changes produced. Many apparently much hypertrophied cervixes return to normal dimension without operation if subjected to a week of preliminary bed rest. The silk sutures should be tied snugly so as to

Some patients who are ready to make good post operative care or we between the time they just seen by the surgeon and the time of operation. Erosion of cervix or incorrectly they fail to mention that the period of erosion.

produce hemostasis but if the tension is too great necrosis and consequent severe and annoying post operative hemorrhage may result (seventh to tenth day). A gauze wick led through the cervical canal to above the internal os secures close apposition of the wound edges.

#### D. ANTERIOR COLPOMIAPHY

(Applicable to all but very large cystoceles always the operation of choice and only to be abandoned if absence of fascial structures is encountered)

*a Exposure* The cervix is grasped with a volsellum forceps and forcibly pulled downward. A small forceps (Ochsner) is applied to the mucosa  $\frac{1}{2}$  centimeter below the urethra. A vertical incision just penetrating through the vaginal mucosa, is made between the two instruments. Starting from below upward the vaginal mucosa is separated from the underlying bladder for a distance of only  $\frac{1}{4}$  centimeter along the entire edge on both sides of the incision. The vaginal flap is made as thin as possible. To each edge two Ochsner forceps are applied (Fig. 17) as tractors. At the very bottom of the incision a few snips of a blunt scissors cut across the so called vesical ligament which serves to attach the bladder to the cervix. The gauze covered finger by stripping upward and backward strictly in the median line now frees the lower margin of the bladder from the cervix (Fig. 18). As this is done on each side fascial fibers running upward and inward become apparent. These are the bladder pillars (the pubocervical ligaments) which are invaluable in the repair (Figs. 19 and 9). Not until this dissection has been completed is it wise to separate the vaginal mucosa to the necessary distance laterally because it is extremely easy to stray into a deeper layer and thus either destroy or repeatedly buttonhole the pillars and the thin fascia which covers them or to detach them from their continuity with deeper structures (anterior part of cardinal ligament).

*$\beta$  Suture* After the vaginal flaps have been reflected and the bladder pushed up well above the peritoneal reflexion (Fig. 19) especially at the sides (behind the pillars) interrupted sutures of chromic gut are passed from side to side — entering one pillar then catching the cervix, and again taking in the pillar

of the opposite side (Fig. 19). The upper suture must be passed with care and not too deeply as the ureters are in close proximity. When these sutures are tied the bladder is held well up and back and is prevented from descending (Fig. 20).

At the upper end of the denudation close to the urethra a strong inverted V shaped fascia will be noted. This forms part of the anterior layer of the triangular ligament. When this is approximated by transverse or mattress sutures of chromic gut, only a small portion of the bladder between the upper and lower sutured areas lacks reinforcement. This weak spot can now be closed as the fascial edges which have become demarcated far laterally by the traction of the tied sutures (and which draw the anterior fibers of the cardinal ligament toward the median line) are in turn drawn together by interrupted sutures.

After resecting a sufficient area of vaginal flap on each side (the amount if not excessive is of little importance) so as to leave an oval denudation the mucosa is approximated with interrupted silk sutures.

By following the above directions closely sufficient fascial structures will be found in almost every case especially in large cystoceles found in conjunction with prolapsus. The fasciae are most often destroyed or lost by operators who form large vaginal flaps or broadly denude as their first step in cystocele operations. Other gynecologists deliberately cut through the pillars in order to free the bladder edges. The bladder can be fully freed behind (i.e. cephalad) to the pillars. These structures are especially valuable not only because they afford good material for suture but also as they serve both as guide and tractor to the deeper parts of the anterior portion of the cardinal ligaments.<sup>1</sup>

In looking up the literature we find that E. Martin (loc. cit.) describes a very similar operation which has been used at Bumm's clinic. The sutures unite the pillars but do not include the cervical tissues in their grasp (Fig. 21).

In the few cases in which no pillars and no fascia can be isolated large cystoceles may be held back by the operation of—

## E VAGINAL INTERPOSITION

The operation has been described so frequently and in such detail that only a few special points need be mentioned.

The incision through the mucosa may be the same as that used for anterior colporrhaphy. Should atrophy of the fasciae show the futility of the usual cystocele operation the denudation is extended farther laterally the remains of the bladder pillars are cut across and the bladder is liberated upward by sharp dissection in order not to push up the movable peritoneal reflection. When the reflection has come to view the lateral bladder pouches are bluntly and widely freed. Hemostasis should be exact and completed before opening the peritoneum.

No differences from the usual technique are used in developing the uterus suturing the peritoneum to the posterior wall of that organ at the level of the internal os (this suture may be omitted) and ligating the tubes if necessary. Two silk sutures are passed below and to each side of the urethra entering the vaginal mucosa passing through the anterior surface of the uterus close to and below the insertion of the round ligament and again passing out through the vaginal flap on the same side. The uterus is now pushed upward and back and behind the symphysis so as to bring it well behind the edges of the levator gap. If possible a few chromic gut sutures fasten the anterior surface of the uterus to the V shaped part of the triangular ligament below the pubic angle. The vaginal flaps are resected and sutured over the uterus. In case of profuse oozing a small gauze tampon is laid between sutures to the anterior surface of the uterus.

Before doing the interposition on all necessary cervical repairs should be completed. In complete prolapse the writer does not employ interposition as he has found the sacro uterine ligaments weak and not dependable structures and their agonal shortening through the anterior fornix an unsatisfactory procedure.

Interposition moreover is not infrequently produces intractable bladder symptoms even in cases in which the anatomical result may appear perfect.

## F COLPOPERINEORRHAPHY

Colpoperineorrhaphy must be considered under three headings depending upon the extent of the tear and upon the structures involved.

a Tears of the perineal body are repaired by reuniting the superficial muscles (transversus perinei superficialis, bulbo cavernosus and sphincter externus) and the transversus profundus and its fasciae (triangular ligament).

β Deeper tears require that the rectum be held back in order that levator ani and its fascia can also be approximated. Above this barrier the rectum must first be supported and reinforced.

γ More pronounced descent of the rectum or of the Douglas cul de sac (enterocele) may result independent of demonstrable lacerations. The cause nevertheless in most instances is directly due to the trauma of child birth. Repair of the lower two segments in these cases would cause but little improvement. The peritoneal reflection may appear at the vulva and the pouch may contain intestine. Not infrequently the anterior rectal wall also prolapses through the vulva as part of the protrusion. The hernial opening is bounded laterally by the sacro uterine ligaments. This upper hernia in the pelvic floor must first be repaired before the levator and transversus are united.

a *Perineorrhaphy*. Almost any operation including the flap splitting gives good results if the tear merely involves the perineum and triangular ligament. This implies that the fascia covering the anterior surface of the rectum has not been torn and that the rectum does not protrude. The edges of the levator muscle rarely recede far laterally under these circumstances. Consequently approximation of triangular surfaces on each side (with base toward the skin surface) restore the parts to approximately normal conditions. As most descriptions of perineal operations deal with the repair of these superficial lesions we so often hear of 100 per cent of cures of uniformly good results.

We employ a simple triangular Hegar denudation reaching the top of the tear. A buried running suture of chromic gut approximates the fascial structures. The mucosa and skin are closed with silk.

β *Colpoperineorrhaphy*. The object is to hold back the rectum and approximate the lower levator fibers (puborectal) and then as in simple perineorrhaphy the accessory structures (perinei profundus and superficialis with their fasciae). The denudation is made from the crest of the rectocele to the labia (triangular Hegar).

The beginner may employ the following method to judge of the extent of the denudation. It must be possible to draw the spot seized as the crest of the rectocele up to the urethral orifice without great tension. The spot selected on the labia must be below the

**Bartholinian openings** The future size of the vulva can be determined by crossing the instruments which grasp the labia in the median line. Of equal importance is the height at which the levator edges and triangular ligament are to be united. The point at which this union is brought about (by the first deep suture) is approximately 2.5 to 3 centimeters within the vulva where the descending rami of the pubes are in close proximity to the lateral vaginal wall. Two instruments catching hold of the lateral tissue at this level (along the line of the proposed denudation) and drawn together in the median line will show the size of the proposed canal and the height of the new perineal barrier. If scar tissue causes the rectum to adhere laterally the bowel must be liberated by pressure with the finger and pushed sufficiently away to expose on each side triangular areas of fascia covering the levator and transversus perinei profundus. Three steps now remain to be taken: (1) the rectum must be held back at a high level, and redundancy corrected; (2) the levators must be brought together; (3) and the perineal body and vulva restored.

(1) *Fixation of rectocele* A horizontal purse string suture is passed starting at the level at which the levators are to be united. The suture first takes a deep lateral bite (levator and fascia) and then passing upward toward the cervix catches the perirectal fascia (fascia recti propria) which is found close to the edge of the denudation finally ending in a deep bite on the opposite side which again takes hold of the levator (Figs 5 and 22). When this suture is tied the upper posterior vaginal wall is found narrowed and the rectum not only held back but also fixed at a higher level.

(2) *Union of the levators* (puborectal fibers) In the median line the finger still can touch the rectum below the first suture. Deep lateral transverse sutures of chromic gut are now passed one below the other (usually three) which take in the fascia covering the levators at their junction with the triangular ligament (Fig. 3). When these sutures are tied the rectum is completely shut off below (Fig. 24).

(3) *Repair of the perineum* as described under perineorrhaphy (a) completes the operation. The operation is much simplified by suturing the mucous membrane step by step as the deep sutures are tied.

Colpoperineorrhaphy not only narrows the vaginal outlet and the lower vaginal canal but also narrows the levator gap and forms a good resilient, sling like perineal body. It likewise fixes the lower portion of the rectum but it fails to hold back either that portion of the rectum situated between the cervix and the new barrier or a deep peritoneal cul-de-sac through which intestine may prolapse in this same region. This upper weak spot is also not affected by ventrofixation of the uterus. Thus though the cervix may be high and fixed the perineum firm the lower vaginal canal narrow yet an uncorrected protrusion may exist in the middle of the vagina. Sooner or later after operation such an enterocele or a high rectocele will then begin to project over the perineal body and extrude through the vulva.

4 *Repair of enterocele and high rectocele* To simplify the operation two areas of denudation are laid out by applying Ochsner forceps. The first forceps is placed at what would correspond to the crest of the rectocele. The cervix is now exposed. With the cervix as the upper point, an Ochsner is placed laterally on each side between the upper and lower limits. An oval denudation of the posterior vaginal wall is then made within these fixed points.

1 The peritoneum may be pushed back, or may be opened and obliterated from within as high up as possible by means of a catgut purse string suture.

2 A slight amount of blunt dissection exposes the sacro uterine ligaments subperitoneally. Laterally the rectum is separated for  $\frac{1}{2}$  inch from the vaginal mucosa. A purse string suture of medium chromic gut is passed taking in the left sacro uterine ligament the posterior wall of the cervix (above the fornix) the right sacro uterine ligament, the rectal fascia, exposed by reflecting the vaginal mucosa. When this suture is tied no protrusion of peritoneum or rectum remains. The mucosa is sutured in turn.

3 The further repair that described under colpoperineorrhaphy.

#### G. ALEXANDER'S OPERATION

The technique of this operation has been so standardized that no description is necessary. If the external inguinal ring is properly exposed without distention of the tissues by hemorrhage or traction the round ligament can be seized and pulled out without even incising the fibers of the external oblique. To fix the shortened ligament either chromo-catgut or silk may be used.

If the uterus has first to be freed before it can be introduced transverse skin incision close to the pubis may be made. Through this cut the abdomen may be opened by a short paramedian vertical incision through the rectus muscle. After the abdomen has been closed an Alexander operation can be performed through the same skin incision. Difficult intra-abdominal manipulations are somewhat hampered by the milliness of the abdominal incision.

#### M. VENTROFIXATION

This operation also has been so standardized that the fundus or the cervical stump may be sutured to the fascia. By extraperitoneal suturing the fundus of the uterus very firm and permanent fixation is obtained. It is well to make the incision paramedian (through the rectus muscle) and to use medium silk for the vital sutures. The fundus should be anchored about two finger breadths above the pubis so as to allow sufficient space for the bladder to expand. Very flabby abdominal walls are unsuitable for ventrofixation as they permit the fundus to draw the pinettes downward and inward in the shape of a funnel. Ligation of the tubes has been previously discussed. Division of the tube between two silk ligatures has sufficient utility.

#### 8. CONCLUSIONS

With very few exceptions anterior and posterior colporrhaphy combined with either the Alexander operation or ventrofixation are applicable to all cases of prolapse or cysto-rectocele and retroversion both during and after the childbearing period.

The technique of these plastic operations can be learned as precisely as that of inguinal hernia if the student is taught the regional anatomy. To obtain the proper dimensions of the reconstructed canal however requires considerable experience and proficiency in operating.

The disadvantage of the described technique is the considerable time required. A rapid operator cannot complete curettage

amputation of the cervix anterior and posterior colporrhaphy ligation of the tubes and ventrofixation in much less than 90 minutes. In some cases (though very rarely) it may prove advisable to perform the vaginal plastic and the abdominal fixation at separate sessions (two weeks interval). Even old women stand this extensive operative interference surprisingly well. Only in the few cases where the general condition of the patient is precarious must interposition of the uterus or vaginal hysterectomy be given the preference because of the shorter time necessary in their execution.

#### 9. SUMMARY

The interposition operation is simple but its disadvantages (necessity for sterilization bladder symptoms recurrence of protrusion after operation for prolapse) have become increasingly apparent. The suture of the isolated levator muscle is illusory and even when the cosmetic results are good a painful scarry perineum is often noted.

The technique described in this article which for repair of cystocele utilizes the pubo-cervical ligaments and anterior fibers of the cardinal ligaments for repair of rectocele unites the fasciae of the rectum the fasciae of the levator muscle and the triangular ligament is very generally applicable the exceptions being few and easy to recognize. Sterilization is not a prerequisite to the operations.

The repair of enterocele and high rectocele is also described. Operations for these rarer conditions are more difficult and atypical.

Recurrences must be expected in at least as many cases as follow hernia operations (in general 1 to 10 per cent).

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## MALIGNANT PAPILLARY ADENOMA OF THE KIDNEY

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From Pathological Department, Nicholas Scott H. P. Bldg.

THE purpose of this present writing is not to enter into a detailed discussion of malignant tumors of the kidney but to draw a parallel between them and the tumor called malignant papillary adenoma of the kidney a condition of sufficient rarity to warrant the publication of a case.

The most frequent tumor of childhood is the one generally known as Wilms' tumor. The histopathology of this class of tumors is so varied that it introduces into the literature a great deal of confusion in regard to diagnosis and nomenclature. The microscopical picture shows a predominance of epithelial cells in some portions of the section. The cells are arranged in tubules and solid masses bearing resemblance to carcinoma.

The tubular structure forms as a rule a characteristic feature of the tumor in other portions of the same section one finds a predominance of spindle and round cells having the appearance of sarcoma. Striped and unstriped muscle tissue as well as hyaline cartilage is frequently met with in sections from this type of tumor hence its name mixed tumor (Fig. 1).

There is no doubt that many a case reported in the literature as carcinoma of childhood belongs to this group of tumors the diagnosis of carcinoma being based probably upon the study of carcinomatous like areas only.

To Burch Hirschfeld (1) we are indebted for having first cleared up the confusion that existed in regard to these tumors. According to him they are embryonal adenosarcomata and are derived from the wolffian body.

Wilms (2) who has made an extensive study of the subject and by whose name they are generally known believes that these so called mixed tumors originate from very early inclusion within the nephrogenic tissue of portions of the primitive myotome.

Busse (3) Trappe (4) Herzog (5) and others have somewhat modified these conceptions yet the pathogenesis of these tumors is

at present by no means a settled question since many data of the embryology of the kidney are still *sub judice*.

The most common renal tumor of the adult is the Grawitz tumor generally known as the hypernephroma. Whether or not this tumor originates in the suprarenal rests as suggested first by Grawitz (6) or results from altered renal epithelium during the process of chronic interstitial nephritis as described by Stoerck (7) is still a debatable question.

The explanation given by Adams (8) is in our opinion the simplest and most rational of the three. According to him they are renal mesotheliomata taking their origin from proliferating islands of nephrogenic tissue (mesoblast) which is derived from fetal wolffian ducts that have never become connected with renal tubules.

Histologically they consist of stroma of capillaries in the meshes of which there are scattered the tumor cells which rest directly upon the endothelium of the capillaries.

They are as a rule large polygonal and refractive. Not infrequently they are arranged in columns bearing resemblance to the cortex of the adrenals. The fat content of the cells if present, constitutes an important diagnostic point however according to Burkhardt (9) it is very often diminished or absent. The presence of glycogen is of little diagnostic significance since a large number of embryonic tissues and rapidly growing tumors contain glycogen (10) within their cells.

Lecithin was found by Gatti (11) to be a constant feature of hypernephroma. However the difficulty of its microchemical detection makes it of little diagnostic significance.

Figure 2 illustrates the histopathology of this type of tumors.

True malignant new growths that originate in the adult renal epithelium are exceedingly rare and it is only within the past few years that they have been differentiated from the above described malignant tumors of the

kidney. The rarity of this class of tumor can be readily understood from the statistics of Albarran and Imbert (12) who found only 13 malignant adenomata out of 529 cases of renal tumors. Tumors described as malignant papillary (cyst) adenoma to which group of renal tumors our case to be described below belongs is still more uncommon. Kretschmer and Moody (13) have collected 10 similar cases from the entire literature and have added a case of their own. With the report of our case there will be a total of 12 cases of adenopapillary tumors of the kidney recorded in the literature.

The history of our case is as follows:

The patient A. H. male age 30 admitted to Nicholas Senn Hospital March 916.

Familial history: father died at age of 56 cause unknown. Mother died of cancer at the age of 67. One brother and four sisters are living and well. His past history was negative except that he was operated on 7 years ago for suppurative appendicitis and a drain was used. He was three weeks in the hospital and recovered nicely.

His present illness began last fall with pain in the stomach region not affected by eating. From this time on he began to get weak. The stomach pains ceased at the end of two weeks and he was free from them until three weeks ago when he had pains in his upper abdomen worse than before. Was in bed two weeks got up for a day and went back to bed again until he entered the hospital.

His physician stated that his temperature ranged from normal to 103. During the last attack he had rather constant pain in the right iliac fossa. He had no headache. He was slightly jaundiced in the beginning of this attack but it had disappeared. He vomited several times recently, his had several chills followed by a rise in temperature. He uses alcohol moderately. Has had no cerebral disease and no symptoms pointing to the urinary tract. He has never had blood in the urine. Has no nocturia or hematuria and urinalysis was negative as to albumin, blood and casts.

Upon entering the hospital he had the appearance of being ill. His temperature was 100.6. Examination of the chest was negative. Abdomen negative except that the liver dullness was two fingers breadth higher than usual. The lower edge of the liver could be plainly felt on a level with the umbilicus. It was smooth and had the normal consistency. A mass could be felt as though protruding from under the liver in the right hypochondriac region. This mass was thought to be the gall bladder a retroperitoneal tumor or the kidney. The mass was not tender and there was just slight tenderness in the epigastrium but in the McBurney region the tenderness and rigidity were quite marked.

Blood examination showed erythrocytes 5,000,000 leucocytes 9,000 polymorphonuclear, 2 per cent large lymphocytes 6 3/4 per cent small lymphocytes 20 1/2 per cent mononuclears 3 1/2 per cent eosinophiles 3 1/2 per cent.

Gastric contents after taking a test breakfast showed: total acid 76, alizarin 40 combined hydrochloric acid 70 free hydrochloric acid 35 total hydrochloric acid 55, acid salts 5.

Occult blood negative with benzidine.

X-ray examination by Dr. F. H. Kuegel. Right diaphragm is flat and 1 1/4 to 2 inches higher than normal. Movement is restricted +-. There is a large shadow which merges with the liver and cannot be differentiated from it extending downward on the right side 1 1/4 to 2 inches below the navel. The stomach examination shows the organ of normal size but vertically placed with the pyloric end pushed to the left of the median line.

On March 6 the patient was operated upon by Dr. A. P. Condon. An incision was made through the right rectus muscle. The mass previously felt protruding beyond the edge of the liver proved to be the kidney from which has sprung a large tumor. The tumor seemed to take its origin from the upper pole of the kidney pushing the kidney downward and forward until it was quite superficial. An incision at right angles to the rectus muscle was made extending well around toward the lumbar region and the kidney and tumor springing from it removed without much difficulty.

The left kidney was palpated but seemed normal. The appendix was buried in adhesions around the cecum it was twice its normal size and the vessels markedly injected the distal third containing a small abscess. The appendix was removed. No enlarged glands could be felt in the abdomen. The fever that the patient had been having was undoubtedly due to his appendicitis. The patient got along well and left the hospital on April 2.

Pathological report. The renal mass measures 10x13x5x1.25 centimeters and weighs 5 1/2 pounds. It presents the appearance of an enlarged kidney and has a nodular surface. The entire mass is covered by a dense fibrous capsule and is of whitish gray color except the anterior part of the middle third of the mass which has the color of a normal kidney. Upon incision the kidney is entirely replaced by the tumor except at the upper and middle thirds. At the upper pole a very narrow zone of kidney tissue measured transversely 3 3/4 centimeters and 5 centimeters longitudinally. This portion of the mass corresponds with the pelvis of the kidney which is filled out with projections of tumor tissue which can be shelled out and in parts leaving behind it a smooth walled pelvic region.

From the middle third the kidney substance passes into the lower pole at which part it cannot be differentiated from the tumor itself.

The tumor mass is subdivided into three distinct lobes which correspond to parts described above. The consistence of the tumor is rather firm in one



Fig. 1



Fig. 2



Fig. 3

Fig. 1 Low power microphotograph illustrating histology of a Wilms tumor. Tumor removed from a boy 23 months old. Tumor was accidentally discovered by mother on hematuria. Patient died 17 months after operation (what was thought to be bronchopneumonia (Metastasis))

Fig. 2 Low power microphotograph showing histology of hypernephroma. Tumor removed from right kidney patient 55 years old (female hematuria for several months Operation May 21 1913. At present enjoy good health.

Fig. 3 Low power microphotograph showing glandular structure of tumor

or two places it is soft. The renal vessels are not invaded by the tumor (Fig. 4).

Section from lower pole shows a very marked glandular proliferation. The lumina of some of the glands are filled with projecting villi which consist of a stalk of connective tissue beset by proliferating epithelial cells. Fine strands of connective tissue are found around aggregations of glands as well as among individual glands. The glands are lined by large cuboidal cells that contain rather an abundance of protoplasm; the nuclei take deep hematoxylin stain and are located at the center of the cells. The cells do not show any fat when stained by sudan III. However there is scattered throughout the connective tissue fat droplets. The lining cells of the projecting villi are of the same character as those of the glands themselves. Section from the middle and upper thirds show a similar picture except some hemorrhage in interstitial tissue.

The kidney tissue adjacent to the tumor presents marked inflammatory changes of the chronic interstitial and parenchymatous character. The sections show newly formed tubules which are elongated and the epithelium shows many mitotic figures. In places one can trace a distinct transition from the newly formed tubules into glandular structure of tumor (Figs 3, 5 and 6).

The existence of a primary adenoma or carcinoma of the kidney is denied by some basing their argument upon the mesodermic origin of the kidney. However we believe that this view is untenable since the renal tubules are lined by epithelium of whatever layer of the blastoderm it comes from and therefore any tumor arising from it can justly

be called adenoma carcinoma or adenoma carcinoma.

An analogous condition one meets with in carcinoma of the uterus although this organ is derived from the mesoderm yet no one will deny the existence of a primary carcinoma of the uterus.

In our case of adenocarcinoma of the kidney we could trace as pointed out above transition from renal parenchyma into tumor formation. The tissue from middle third of

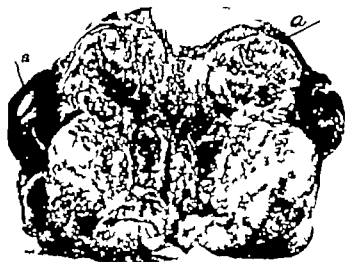


Fig. 4. Note extent of tumor which replaced kidney tissue except at upper (a) and middle (b) poles. Section for microscopical examination taken from upper middle and lower thirds stained by hematoxylin and eosin (Van Gieson) and by sudan III for fat (frozen section).





Fig. 5



Fig. 6



Fig. 7

Fig. 5. High power microphotograph of a renal tumor showing a tubular structure. Fig. 6. Low power microphotograph of a renal tumor showing a tubular structure. Fig. 7. Low power microphotograph showing the tendency of a renal tumor to mimic the tubular structure of the kidney.

tumor showed great tendency to mimic tubular structure of the kidney (Fig. 7).

Whether or not the chronic inflammatory changes of the kidney have anything to do with the formation of the tumor cannot be stated definitely, yet that it may play a part in tumor formation seems to be quite a logical supposition. It is well known that chronic gastritis or chronic ulcer of the stomach often is followed by cancer formation. That adenomatous epithelial tissue can take origin from kidney tubules was recently pointed out by Dunn (14).

#### SYMPTOMS AND DIAGNOSIS

From the few cases reported in the literature it will be impossible to build up a clinical picture from which this kind of renal tumors could be diagnosed. Suffice it to say that the diagnosis must remain that of renal tumor and it is left to the pathologist to diagnose the nature of the tumor. Among the symptoms which are in common with other renal tumors hematuria was observed in 8 out of 12 recorded cases. Colic was a rather constant symptom being present in 11 out of 12 cases.

#### AGE

All but three occurred in people past 40.

As regards sex there were three females and nine males. The prognosis depends upon

early operative interference. If there has been no metastasis at time of operation the patient stands a better chance of remaining free from recurrence than if affected with any other malignant tumors of the kidney.

Although too short a time has elapsed since the operation to judge upon recurrence in our case yet X-ray plates taken at the time of his dismissal from the hospital failed to reveal any metastasis in any part of the body.

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## OPISTHOTONUS FŒTUS

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THE condition here presented may be considered under three headings (1) the rarity of the presentation (2) the difficulty of diagnosis (3) suggestions as to the management of such cases

The condition can best be defined as an opisthotonus of the foetus with the concavity of the back directed downward and slightly forward with extension of the thighs and extension of the arms over the head. A con-

sideration of the accompanying illustrations gives the best idea of the condition

A careful review of the literature and of the various textbooks reveals no pictures or descriptions of a similar condition. Dr C S Bacon says he has never seen such a case and knows of none in the literature. Dr J W Williams in a personal communication says he has never seen such a presentation and the only references that he knows of in the litera-

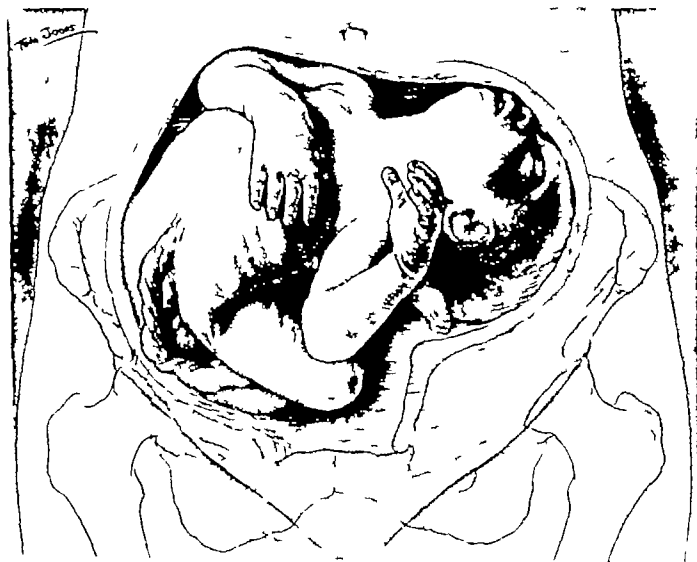


Fig. 1. The drawing illustrates the conditions present when delivery became imperative because of the poor quality of the fetal heart tones. Note that the arm has descended so that both elbow and knee can be felt in the partially dilated cervix. Spontaneous version and delivery can be seen to be highly improbable respectively of the condition of the child.



The 1. N to the exten on of tl arm or the head  
an l. of the N m the l mo of p sentat on  
J u l. two ell li trat d I femur H b merus  
ter l. or l t l l pel Se crual Sy ter or

ture are two which he has kindly sent me. They have to do with fanciful drawings in some old obstetrical books.

Dr. J. B. De Lee in a personal communication tells me that he had a similar case about ten years ago. The child was delivered with great difficulty. He emphasizes the difficulty of diagnosing these presentations from external examination. Dr. J. Clarence Webster states that he has never seen a similar case, and his nephew of one being reported

It therefore would appear that this condition is so uncommon that a descriptive desiderium. Inasmuch as I have been unable to find a counterpart in the literature the nomenclature *status epilepticus* is suggested for this position. The difficulty is highly significant. The physical findings are bizarre and confusing. The problem is well illustrated by the case at hand.

nodules mass resembling a breech was palpable  
th inlet. The heart tones were in the left upper  
quadrant. Vaginally small part could be felt  
through the lower uterine segment. The pelvis  
of good size and no grossly enlarged lymph nodes  
could be felt. The cervix was not felt or  
flushed.

I tentatively diagnosed a transverse presentation with shoulder presenting and was made an attempt to make a vaginal delivery. I was unable to do a complete turn because the mother or the inlet could not be displace although the head could be moved on until it came to be almost over the inlet. On releasing the head it returned immediately to its former position. This rather free mobility of one pole of the fetus with an apparent fixation of the opposite pole seems to me to be a rather significant sign but at the time I was unable to interpret it. The findings were confirmed by Dr. B. and I then had a X-ray examination made. Topographs were taken but unfortunately they were not very clear. They gave enough detail however to establish the diagnosis although at the time was considered sufficient and so further X-ray pictures were not made.

A second erosion, as attempted in the light of the knowledge of tunnel from the X-ray, did indeed flex the body at the same time. Again the erosion was unsuccessful due in part at least to an increased brittleness of the uterine and bony wall at this time.

Differential diagnosis before the X-ray as taken  
of each individual case

First transverse presentation with the shoulder  
prone lying as shown red. The points against this  
are the inability to accurately map out the breech  
except for the nodula mass over the nuchal ridge  
pressure of the heart tones in the left upper quad-  
rant. The other findings right, ryl, ll, h, c  
f, t, d, t, r, t.

S o n l y I g n a y h o n e l a b y t n e  
 e n e t h p o t e p e k i g g n t t h i s e r t h e  
 b a c c i s e d h e r t l i t h a b d n e u s o  
 t u l y l t k d o n l y o n e h e d o u l d b e i a l p a t r e d  
 t h r e n o u l t l y o f a n a l l p a r t

Therby te of on ty Thus of our  
uld is bl ruld u e ternal  
x m t or

was perfectly formed and no bony defects could be noticed on careful examination

In the present case it was thought best to allow the woman to go into labor without any special treatment. The membranes ruptured shortly after the labor started and she entered the hospital with the cervix dilated to the breadth of two fingers.

Internal examination revealed a knee and elbow presenting. This I could determine accurately by following the forearm up to the hand and the thigh up to the genital fold. After attempting an external version again, even though it offered little hope of success, and failing, it was decided to allow labor to proceed to see if spontaneous version would occur. After four hours of rather good pains the baby's heart tones became very faint, and the pains became very weak. The cervix was only about three fingers dilated but it was decided to deliver the woman at once in the interest of the child. Dr. Rohrlach did an easy extraction, but the child which was in asphyxia præluda could not be revived. Efforts in this direction were maintained for over an hour. A post mortem examination was refused by the mother. No abnormality could be detected on careful external examination of the body.

In reviewing the case I believe that a better way to manage such a presentation would be

to insert a bag outside the membranes as soon as the pains start. The object of this would be to protect the membranes until complete dilatation of the cervix and so preserve the liquor amnii for the subsequent version. If the membranes were ruptured at the time the case entered the hospital, as in this case a bag placed in the uterus would hasten complete dilatation of the cervix and hence save some time in case delivery became imperative on short notice. Version and extraction should be done when the cervix is completely dilated.

#### SUMMARY

These cases are very rare.

They are difficult to diagnose by physical examination.

They can be easily diagnosed in the late months by roentgenograms.

They should be diagnosed and corrected early, i.e. in the seventh month if possible and failing in that should receive special care at the time in labor.

## TECHNIQUE OF AND OBSERVATIONS ON THE OPERATION OF VASOPUNCTURE AND MEDICATION FOR SEMINAL VESICULITIS

BY B. A. THOMAS, M.D., F.A.C.S., PHILADELPHIA

F. &amp; T. M. L. Y. Co. P. L. Ho. and C. Geo. Co. Va.

It is undoubtedly universally admitted in urological circles today that the treatment of seminal vesiculitis or spermato cystitis is the most discussed subject in genito-urinary surgery. Unfortunately but naturally different opinions are entertained as to the most appropriate method of procedure in any given case. The disagreement is attributable to three causes: first certain operators are partial to their own suggestion respecting operative procedures; second many overconservative practitioners specialists and others have not yet been sufficiently convinced that surgical attack on the seminal vesicles is indicated; and third a number through ignorance or lack of surgical skill decry *a priori* surgical procedures.

Variable as may be the view of urologists as to the particular form of treatment in inflammatory disease of the seminal vesicles they are at least united in belief that these small structures too often overlooked if not forgotten by the general practitioner are very commonly loci for local and systemic affliction of the highest magnitude. Therefore it devolves logically upon our specialty to blaze the trail for and elucidate not only the general practitioner but the general surgeon the internist the orthopedist the neurologist and the psychiatrist to the fact that too often they are employed in the treatment of patient misquailing under a retinue of vague and remote symptoms the cause of which is little suspected.

Although inflammation of the seminal vesicles was known to Mercur in 1745 their diseases extensively described by Cueliot in 1861 their periodical incision and drainage first done by Livy in 1888 and their removal first accomplished by Ullmann in 1890 it remained for Fuller and Bellfield above all other to popularize and place the surgical treatment of gonorrheal spermato cystitis on a practical basis. These

pioneer for their unsullied conviction in the value of vesiculotomy and vasostomy the profession and humanity at large owe a debt of perennial gratitude.

The subject of this paper is one to which the author has previously given some consideration. At this time it is desired simply (1) to point out certain anatomical features not previously mentioned (2) to describe and illustrate in greater detail the operation of *vasopuncture and medication for spermato cystitis* (3) to note the results to date following the surgical procedure.

*Anatomical considerations.* There are certain anatomical features characterizing the vesiculæ seminales including the ampullæ of the vas deferentia and the ejaculatory duct that must be thoroughly comprehended before a proper conception can be formed of the true nature extent and gravity of inflammation located in these structures or before any adequate treatment can be applied. They may well be styled the male fallopian tubes not only because Fallopius was the first to describe them but also and particularly because of the extreme and almost equal difficulty in eradicating resident inflammatory disease as compared with homologous inflammation located in the uterine adnexa.

The anatomical relationhip of the seminal vesicles (Figs. 1 and 2) to the peritoneum bladder ureters prostate and rectum explaining a composite symptom complex when the seat of inflammation need not be cryptic before this audience. Moreover all authors have treated this phase of the subject religiously realizing its importance not only symptomatically but also with respect to treatment in view of draining or removal of these organs. Respecting the unit medical configuration of the vesicle themselves in



Fig. 1. Observe the intimate association of the seminal vesicles to the bladder and ureters explaining the reason for interference with ureteral drainage when the vesicles become distended with pus also the bladder symptoms of irritability and retention in perivesical vesiculitis with infiltration of the bladder wall. Note the poor drainage afforded by the interior anatomy of the vesicle.

their relation to the clinical features of spermatozoostitis the work of Picker stands as a classic subject however to modifications dependent upon future revelations so far as observations on the living subject are concerned.

Suffice it to say that the seminal vesicle divested of its closely adherent surrounding fibrous tissue is a tortuous blind duct with diverticula varying in length from 6 to 28 centimeters and in capacity from 3 to 11.5 cubic centimeters. The terminal end of the duct ends in a return curve or hook like projection the tubular diverticula numbering four to eight or more branch from the main duct at various angles and in different direction adding to the complexity of the lumen by their own tortuosities (Piersol). Invested in its capsule normally the organ usually



Fig. 2. Patient never had venereal disease. Seminal vesicles normal had seminal colliculectomy for fibroma one month prior to collargolgram. Note tortuosities of vasa deferentia. Observe radiographic catheters in ureters and relationship of same to vesicles/seminales.

measures from 4 to 5 centimeters in length by 2 centimeters in breadth and 1 centimeter in thickness. On cross section the vesicle presents an irregular constricted and sacculated lumen marked by fine ridges and pits (Figs. 1 and 3) although a histological section portrays to better advantage the delicate cryptic interior (Fig. 4). Whether or not in addition to this honeycombed condition of the interior the mucosa also possesses glands is still a disputed question with the evidence in my opinion strongly in favor of the negative. Presumably in the past the small mucosal pits were mistaken for glands. The lining of these crypts a single or imperfect double layer of low columnar epithelium is unquestionably the same as that of the adjacent parts of the lumen although manifesting secretory activity indicated by the number of goblet cells present concerned in the production of the well known peculiar fluid identified with these structures. The point at issue is that these minute diverticula permeating the epithelium are capable of harboring infection equally as well as true glands.



FIG. 4. Photomicrograph of emulsi- The interior of the ampulla is completely lined by the dermal epithelium. The ampulla is a large, thin-walled structure, the lumen of which is filled with the contents of the epididymis. The ampulla is a large, thin-walled structure, the lumen of which is filled with the contents of the epididymis.

The question naturally arises whether the inflammatory products can best be eliminated from these milky caverns by the scalpel, medication or massage. The orifice of the vesicular duct at its junction with the vas deferens is large in comparison with the lumen of the ejaculatory duct below, thus facilitating the filling of the vesicle with any temporary content of the ampulla before it becomes propelled into the ejaculatory duct. This point



Fig. 5. Photomicrograph of longitudinal section of the ampulla of the vas. Observe the finely lined internal structure of the ampulla, differing only in degree from the internal anatomy of the testis.



FIG. 4. Photomicrograph of emulsi- The interior of the ampulla is completely lined by the dermal epithelium. The ampulla is a large, thin-walled structure, the lumen of which is filled with the contents of the epididymis. The ampulla is a large, thin-walled structure, the lumen of which is filled with the contents of the epididymis.

should be thoroughly appreciated and if so may assist in appreciation of the rationale of emulsi vesicle medication for the cure of inflammation of these structures.

Developed similarly from the cavity of the Wolffian duct the ampulla of the vas deferens must receive serious consideration if we are to study properly inflammatory disease of the organs in this more or less inaccessible anatomical region. It will be remembered that the ampulla is a tortuous sacculated canal possessing diverticula and a honeycombed interior, differing only in degree from the anatomy of the perimastic vesicle (Fig. 5). Invested by its fibrous tissue it measures 3 to 4 centimeters in length and 7 to 10 millimeters in its greatest width (Pierson). Undoubtedly the inner alveolar anatomical structure of both seminal vesicle and ampulla can be better realized by roentgenographic study (Fig. 6 and 7).

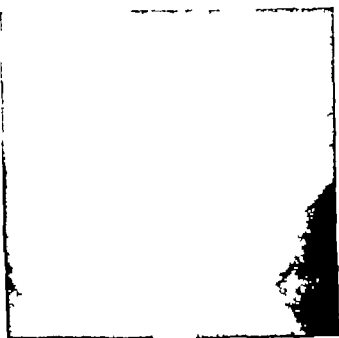


Fig 6 Chronic seminal proovesiculosis. Fifty minims of 10 per cent collargol injected into each side

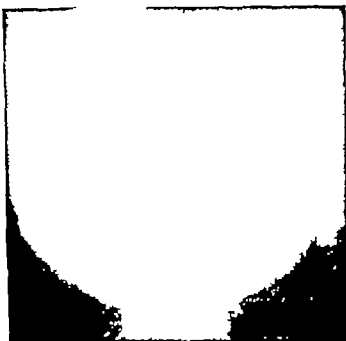


Fig 7 Chronic seminal vesiculitis (bilateral). Light minims of 10 per cent collargol injected on right side and seventy on the left. Note very large ampullae of vasa deferentia and courses of the latter on both sides

The third consideration of importance relative to the drainage of the spermatic tract is the anatomy of the ejaculatory duct particularly certain diverticula and the presence and activity of the sphincter spermaticus. The upper segment about 3 centimeters in length corresponds to a double passage, one the continuation of the vas and the other the vesicular duct resulting by their union in the so called ejaculatory sinus (Felix). Distally from the sinus the duct proper becomes the site of five or more appendicular structures (Weisz) obviously capable of harboring latent infection. Thereafter the course of the ejaculatory duct remains fairly straight coursing through the prostate where its wall exhibits an intimate connection with the fibrous muscular and glandular tissue of the prostate (Porosz) (Fig 8) lying in relationship to the median and posterior lobes. Coursing almost parallel with the urethra the duct suddenly bends upward to penetrate the urethra. At this level the walls suddenly become thicker exhibiting many involuntary muscle fibers and in the connective tissue can be seen a few red stripes (Van Gieson's stain) marking the beginning of the sphincter (Fig 8). This portion of the duct is 3 to 5 millimeters in length and

its lumen measures about 1.5 millimeters in diameter. The ducts one on either side after piercing the urethral wall assume marked curvatures diverging about the utriculus with an angular deflection of about 90 degrees and coursing upward through the colliculus and then at the level of their orifices again bend with the result

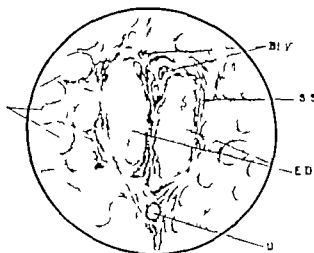


Fig 8 Showing the relationship of the ejaculatory ducts surrounded by the fibers of the sphincter spermaticus to the prostate tissue. ED ejaculatory ducts, S spermaticus, Pr G acini of prostate gland, U utriculus, B blood vessels. (Modified from Porosz)





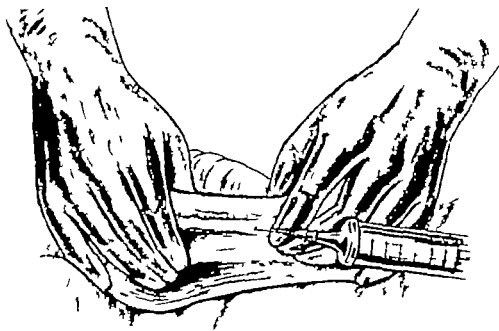


Fig. 10. Presentation of scrotum in properly held position for infiltrational anesthesia.

and delicate nerves supplying the spermatic tract. Both pale and medullated fibers from the hypogastric plexus of the sympathetic system constitute the deferential plexus and their filaments penetrate to both the muscular and mucous coats (Schwano, Timofeev). The nerves supplying the vesicles are even more numerous and have their derivation in part directly from the hypogastric plexus or as secondary plexuses following the hemorrhoidal and vesical arteries (Frenkel). Thus in this ordinarily obscure disease owing to the correlation of the pelvic prostatic and vesical with the hypogastric lumbar and sacral nerve plexus the presence of pains referred to the back, lumbar, hypogastric and perineal regions, also the hip joint and sacroiliac synchondroses and the thighs becomes readily explainable.

**Treatment of seminal vesiculitis.** Space forbids and moreover the purpose of this paper is not to present a detailed description of the various methods, conservative and radical, concerned in the treatment of seminal vesiculitis. Although my present intention is to describe more in detail the technique of an operative procedure — *vasopuncture and medication for seminal vesiculitis* — which was briefly described two years ago I wish it

emphatically understood that I do not regard the operation *per se* as a cure-all for the majority of patients afflicted with this intractable disease. Indeed I fully appreciate the fact that there are a number of cases and have so treated them in which vesiculotomy, vesiculectomy, vasostomy or even vasotomy are primarily indicated and with whom *vasopuncture* and vesicular medication would avail naught. Obviously *vasopuncture* and for that matter also *vasotomy* and *vasostomy* are contra-indicated in patients having strictures of the spermatic duct save for diagnostic purposes. Certainly in cases exhibiting a marked seminal pyovesiculosis or extensive perivesiculitis endovesical medication is likely to prove futile. Indeed in the latter condition particularly those causing fibroid induration of the base and neck of the bladder with vesical obstruction and retention of urine as recently described by Belfield and frequently observed by the author, vesiculectomy is doubtless the preferable operative procedure. On the other hand in cases where the vesicles are essentially localized abscesses, vesiculectomy possesses great merit if all the collections of pus are opened. I would raise a warning hand, however, to the effect that vesiculotomy is



F. Illustration of the formation of the new flat line of the fold



I. Substitution of grooved line for the prolapsed and distended line of the incision at the abdominal sheath (center for freedom of the back fascial thickness)

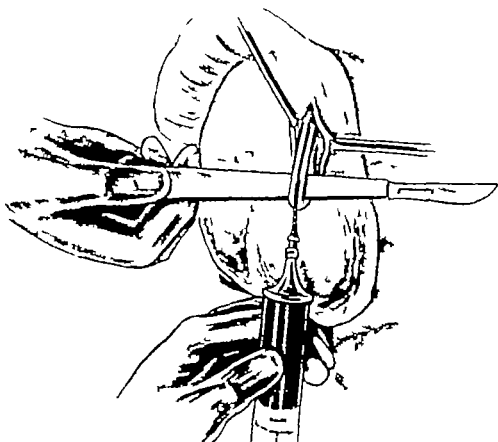


FIG. 13. Vase put on stretch over handle of scapel preparatory to insertion of needle of syringe and injection of medicating fluid.

not always a curative procedure also that it is not always well or properly done indeed in many cases impossible of perfect accomplishment. Moreover I am confident that many patients are subjected to the operation when it is not strictly indicated and who could have been just as well if not better treated by less formidable measures. I have repeatedly observed vesiculotomies performed on patients in whom as good if not better results could have been obtained by appropriate massage, vasopuncture and medication of the vesicles associated with or without autogenous bacteriotherapy.

Doubt has been expressed that massage, time honored and universally practiced in the treatment of subacute and chronic prostatitis and seminal vesiculitis is of value *per se*. Too vigorous massage unquestionably may be harmful. Carefully and properly applied it commonly results in relief of symptoms in certain types of cases just as in medication of the vesicles when aside from the germicidal

value of the drug there occurs a mild intra-vesicular reaction which upon subsidence apparently results in eradication of the latent infection.

Impartial thought relative to the treatment of seminal vesiculitis is bound to rise in the mind of the conscientious surgeon a number of pertinent questions. (1) Is it possible in view of the anatomical considerations herein presented by vesiculotomy to drain every focal abscess in the infected spermatic tract especially if the incision is made in the dark or by the sense of touch? (2) If possible is it done routinely or does the operation afford only partial cure leaving behind a number of infective foci to perpetuate

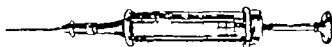


FIG. 14. Record syringe equipped with bayonet attached needle employed for injection of mass and excise.





Fig. 17 Closure of skin with continuous suture of chromic catgut

nearly filled that no intensity occurred in the vesicular shadow after 3 cubic centimeters had been injected and that there was no escape of the silver solution from the in lying urethral catheter until after the vesicle was filled. (8) What is the danger of adding to the infection in the seminal vesicle from the operations of vasotomy and vasostomy? (9) Do these operations ever result in stricture of the vas deferens? (10) Is the postoperative funiculitis incident to the regurgitation of various silver preparations injected into the vas in vasotomy and vasostomy as it is usually performed not a considerable matter greatly discounting the utility of these operations? (11) Finally is it not an excellent surgical principle to utilize and rely on minor procedures until they have been proved to be inadequate adopting major practices not routinely but only in selected cases?

*Technique of vasopuncture and spermato cystic medication.* The patient should take a cathartic the night before the operation. Immediately before undertaking the operation the seminal vesicles should be massaged and emptied of any contained inflammatory products. The operation may be conducted as an office procedure although it is advisable

to carry it out either at the home of the patient or in a hospital where he can remain quietly in bed for two or three days thereby avoiding movements that may provoke the vesicle unduly to contract and expel its medicinal content. The scrotum should be shaved but may not be shaved since it is sufficient after thorough antisepsis merely to clip the hairs short at the operative site.

1 A good assistant isolates and properly fixes the vas in the neck of the scrotum while the operator infiltrates the overlying skin with a 1 per cent cocaine or a 1 per cent novocaine solution in suprarenin 1:300,000 (Fig. 10).

2 A longitudinal incision about  $2\frac{1}{2}$  centimeters in length is made through the skin and fascial sheaths everting these with Allis forceps and hemostats respectively and the vas isolated and brought out of the wound on the curved flat end of a probe (Fig. 11).

3 The probe is substituted by a grooved director and particular care exercised to free the vas of its most intimate fascial investment thereby facilitating the introduction of the needle at the same time the vas is stripped of its fascial attachments for a short distance (Fig. 12).

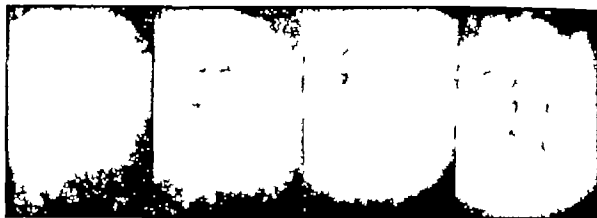


Fig. 8 The border of radical high penile protuberance is shaded by the proteolysin contained in the minimal doses net through the anastomosis after

puncture and spermatozoa medication (Slide-trans taken through the courtesy of Dr H. K. Pearson.)

4 The handle of the scalpel is now slipped through the loop of the vas and slight traction made (Fig. 13) as the needle of the special Record syringe (Fig. 14) is cautiously introduced at the level of the edge of the handle of the scalpel as illustrated. About 2 or 3 cubic centimeter of sterile water contained in the syringe are first injected to determine the patency of the vas or better a solution of methylene blue employed when with a catheter placed in the posterior urethra the condition of the ejaculatory duct can likewise be determined. Should a stricture of the vas be detected no injection of a medicating solution should be attempted since the fluid is sure to back flow through the path of the needle puncture and infiltrate the cord causing a disagreeable funiculitis and epididymitis. In the absence of any obstruction the syringe filled with protein colloid or other silver preparation and from 3 to 5 cubic centimeter of the solution slowly injected.

As the needle is withdrawn pressure by gauze prevents back flow and subsequent reabsorption and extravasation into the spermatic cord is prevented by the introduction of a very fine plain cat gut suture through the outermost coat of the vas (Fig. 15). *This suture is of the utmost importance and properly introduced effectually prevents any leakage of silver solution through the path of the needle puncture which will otherwise in the structure of the cord resulting in a painful*

*persistent and well-irritated chemical funiculitis.*

6 The vas is then dropped and the fascia closed with a continuous fine suture of plain cat gut (Fig. 16).

7 The skin is closed with a continuous suture of chromic catgut (Fig. 17) the incision touched with Whitehead's varnish and a dry gauze dressing applied supplemented by a suspensory bandage.

*Results of treatment.* Appreciating the chronic and deep seated character of the infection in many of these cases of seminal vesiculitis it is obvious that an immediate brilliant cure following the operation of *asopuncture and spermatozoa medication* as with any other therapeutic agent is to be expected in only a minority of patients. Nevertheless the marked improvement in the great majority over and above that obtainable by massage and bacterin therapy alone or conjointly has been truly gratifying and although insufficient research has been carried out with the application of this treatment in chronic subacute and even acute cases I am optimistic in the belief that it may enjoy a routine place in treatment of the cystic types of cases. An analogy is exemplified in renal lavage and medication for pyelitis the utility and value of which is unquestionable in certain cases.

Indicative of therapeutic effect following vasopuncture and injection of the vesicle with

collargol, the urine appears black or dark brown for a couple of days and shows, macroscopically by its rusty color the presence of colloidal silver for about a week the persistence of the silver content in the vesicle may also be shown skiagraphically, as can be seen in Fig 18 taken on consecutive days following vasopuncture and spermatocystic medication microscopically, after massage brown crystals of the drug have been discovered from two to four weeks after the operation. Thus my own experience dictates the superiority of vasopuncture over vasotomy or vasostomy, the latter being attended with definite disadvantages, moreover if necessary it is a simple matter to repeat puncture of the vas.

The thought naturally arises as to whether or not there are any dangers attendant upon *vasopuncture and medication*. The only possibilities worthy of consideration are sterility incident to a chemical epididymitis stricture of the vas and incarceration of an irritating chemical solution within the spermatic tract owing to stricture of the ejaculatory duct. I can only say that in an extensive, although limited series of cases I have never observed either of the first two misfortunes and the latter can easily be obviated by the observance of proper technique. The danger of funiculitis from chemical invasion of the cord unavoidable in Belheld's vasotomy is not a consideration in vasopuncture if the technique be perfect.

I have utilized various silver preparations, chiefly a 10 per cent collargol solution owing to my interest primarily in studying skiagraphically the living pathology of the seminal vesicles. Therapeutically I am inclined to believe that a 5 per cent solution is equally efficient and possibly less irritating. Among other preparations employed may be mentioned protargol  $\frac{1}{2}$  to 1 per cent, silver nitrate 1 to 2 per cent, emulsion of argentic iodide 5 per cent, argyrol 10 per cent, and a new preparation of silver protein 20 per cent. This last is a product of the Hare Chemical Laboratory of the University of Pennsylvania and has been found to contain 40 per cent metallic silver is quite penetrating un-irritating to mucous membranes even in 70

per cent strength and is inexpensive comparatively with collargol.

Specialists in genito urinary surgery are only too well aware of the great multitude of patients who in spite of well executed massage, for months indeed for years, persist in exhibiting an abnormal number of pus cells in the urine containing expressed spermatic contents. These are the patients in the author's experience on whom *vasopuncture and medication* is expressly indicated and its performance at this time may prevent the occurrence of a pyovesiculosis and render for the future vesiculotomy or vesiculectomy unnecessary. Although chiefly indicated in subacute also probably chronic and possibly acute catarrhal spermatocystitis, rather than in interstitial or periseminal vesiculitis I have nevertheless, observed that in a number of cases of chronic pyovesiculosis some the victims of a recurrent epididymitis others complaining of urinary vesical urethral, genital nervous and mental disturbances many afflicted with arthritic and so called rheumatic pains and one exhibiting a constitutional disorder manifested by a typical gonorrhoeal roseola vasopuncture and vesicular medication sufficed to produce at least a *symptomatic cure*. I do not believe that in all patients sufficient time has elapsed to guard against recurrences or to state definitely that the local infection has been permanently eradicated. With many microscopical pictures of spermatic content urine although frequently the field is simply loaded with pus-cells, after medication of the vesicles a normal appearance is not infrequently observed. These results have been obtained in a number of cases a month or two after operation in the absence of any supplementary treatment whatsoever although in the majority, if after a few weeks the microscopical test be repeated and an excessive number of pus cells be found a certain amount of massage and even repetition of the *vasopuncture and medication* should be practiced.

In a careful analytical study of 94 cases of seminal vesiculitis most of which were typified by the chronic form of the disease, in 69.2 per cent satisfactory treatment was accomplished by massage and irrigations



TABLE OF ANALYSIS OF SPERMATOCYSTITIS SUBJECTED TO VASOPUNCTURE AND MEDICATION

No	Name	Complaint one	Duration	Attacks of Gonorrhea	Discharge	Number Cells to Microscop Field Below Vasopuncture	Number Cells to Microscop Field Above Vasopuncture	Massage Anus or Operation	Time Since Operation	Result
	R. B.	Perineal pain	yr		+	6		h	M	Cured
	H. T. W.	Perineal burning	3 yrs		+	40		No	16 yrs	Cured
	E. U.	Perineal and vesical pains	yr		+		{ } 3	Yes	yr	Improved
	E. I. B.	Gonorrhea to scrotum	yr	4	+	?	Loaded	Yes	yr	Improved
1	E. B. M.		6 mos	?	?		6	No	3 mos	Cured
2	W. G. O.	Tubercular	yr		+			No	mos	Cured
3	E. J.	Perineal and rectal pains	6 yrs		+	8		No	mos	Improved
4	P. J. K.	Lumbar pain	yr		+	8		Yes	yr	Cured
	L. F.		yr		+	7		Yes	3 mos	Cured
	A. C.	Spermatorrhea	4 y	?		0-		No	mos	Cured
	T. B.	Stricture of vas Epididymitis	14 mos		+	Loaded	Loaded	Yes	6 wks	Nil
	C. A. W.		8 mos		++	?	6	Yes	yr mos	Improved
13	E. B. T.	Stricture of vas Epididymitis	3 mos		+	8	?	?	yr 3 mos	Nil
14	C. S. F.		6 1/2 yrs		+	14		No	3 mos	Cured
15	R. W. O.	Epididymitis	mos		+	Many	5	h	mos	Cured
16	D. D. S.	Stricture of vas	7 1/2 mos					N	mos	Cured
17	H. H. W.		mos		+	5	Many	Yes	14 mos	Nil
18	H. P. M.	Epididymitis	7 mos		+	20	2	Yes	10 ks	Cured
19	T. W. McD.		3 mos		+	35	?	Yes	4 mos	Improved
20	G.		?	?	+	?	?	Yes	?	Improved
	J. B. B.		mos		+	?	8 to	Yes	yr	Improved
21	A. A.	Epididymitis	yr		+			Yes	ks	Improved
22	J. C.	Epididymitis	3 mos		+	20	?	Yes	1 wks	Improved
23	E. A.		3 mos		+	?	40	Yes	mos	Improved
24	T. M.		mos		+	3		Yes	mos	Improved
25	R. S.		3 yrs	3	+	?	?	Yes	mos	Improved
26	C. J.	Stricture of vas Impotence	3 yrs	3	+	?	?	Yes	yr	Improved
27	W. M. H.		yr		+	7+ changes	0-4	No	yr	Cured
28	A. L.	Epididymitis	yr		+	Loaded	?	Yes	mos	Improved

supplemented in many cases by the alteration of a good polyvalent gonococcal and autogenous bacterins. Obviously in those associated with chronic prostatitis and posterior urethritis massage urethral dilatation total irrigations topical applications and other instrumentation was carried out when indicated. These 94 cases represented a manifold and far reaching symptomatology in order of frequency of occurrence as follows (1) pain, (2) urinary (3) epididymic (4)

arthritic and rheumatic (5) osteoperiosteatic (6) nervous and mental (7) impotent (8) renal (9) pleuritic (10) cutaneous and (11) cardiac. Approximately one half of all cases had no symptoms directly referable to the seminal vesicles the diagnosis having been established by rectal palpation massage and microscopy in patients presenting themselves on account of a urethral discharge.

In 30.8 per cent of cases (see table) for the data on some of which I wish to thank my

associate Dr J C Birdsall, the operation of *asopuncture and spermatozystic medication* was performed with the result of cure in 37.9 per cent, improvement in 52 per cent and no improvement in 10.1 per cent. Furthermore it is to be borne in mind that in the majority of cases subjected to vasopuncture, massage was practiced for variable periods until the condition of the patient became stationary that graduated massage was necessary to supplement the vesicular injections in the majority of cases that the infection was bilateral in three fourths of the cases that the disease had endured for two months to twelve years before injection was done that in some cases vasopuncture and medication must be repeated that 27 per cent of the operations were in cases complicated by epididymitis and that 50 per cent of the epididymitides demonstrated a stricture of the vas between the neck of the scrotum and the seminal vesicle.

A review of the study of seminal vesiculitis here presented may justify the following conclusions:

1 This paper supplementing a previous one on the subject of seminal vesiculitis is not intended to be the final judgment on the value of spermatozystic medication by vasopuncture but rather to present certain convictions and deductions to date relative to important anatomical and clinical facts.

2 The technique of the operation of vasopuncture as here described and illustrated appears to obviate certain objections encountered in vasotomy and vasostomy.

3 By virtue of the anatomical nature and relationship of the vesicle vas and ejaculatory duct and in consideration of the fact that when the vesicle is infected the other two are in a similar state internal medication of these intricate structures if practicable and attended with beneficial therapeutic results appears strongly as an appropriate method of treatment.

4 The pathological condition present in each individual case should be the determining factor in the selection of the proper form of treatment. Vasopuncture and injection is of service, primarily in many cases in determining the applicability of more

radical procedures as vesiculectomy or vesiculectomy.

5 Owing to the impossibility or at least the impracticability of incising and draining all the infected diverticula or recesses of the vesicle in the treatment of patients not amenable to massage and medication a serious thought arises whether or not we should try to perfect a better technique and perform vesiculectomy in many cases in preference to vesiculectomy.

6 Spermatozystic medication is not possible in cases with stricture of the vas between the external ring of the inguinal canal and the seminal vesicle moreover it should probably not be employed when the ejaculatory duct is strictured.

7 Vasopuncture and spermatozystic medication apparently offers an important aid, supplementing or preceding massage in the treatment of seminal vesiculitis whereby in the experience of the author approximately 40 per cent of patients have been cured at least symptomatically and over 50 per cent improved.

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# A POINT IN THE DIFFERENTIAL DIAGNOSIS OF PYURIA TOGETHER WITH REMARKS ON LAVAGE OF THE KIDNEY PELVIS

By ARTHUR H. CURTIS, M.D., F.A.C.S., CHICAGO

**A**SOURCE of difficulty in the differential diagnosis of pyuria is the failure to obtain a flow of urine through the ureteral catheter. In most papers concerned with the diagnosis of ureteral and kidney lesions this trouble receives scant attention but occasionally as in a paper by Bransch<sup>1</sup> the frequency of annoyance from this source is frankly admitted.

To obviate a dry tap certain procedures are customary. Above all the catheter must be examined to insure patency and ample time must be allowed to overcome reflex anuria. In case urine is temporarily suppressed stimulation of the kidney secretion—both psychic and organic—is secured through administration of water by mouth.

When urine does not appear within a reasonable period it is usual to inject a sterile solution through the ureteral catheter. This may yield good results often it does not. For the past five months I have used another method the technique for which is herewith described.

If urine is not obtained the catheter is withdrawn from the ureter and a second catheter passed. In the event of persistent failure of urinary flow an empty Luer syringe is applied to the large end of the ureteral catheter which had been used first and the catheter contents are forced out upon a glass slide. Examination of this material yields a diagnosis in most dry tap pus infection cases. Usually there is considerable stringy mucoid material in addition to other pathological constituents. This procedure has several times clinched a diagnosis when it would otherwise have been impossible or possible only by exclusion. The frequent help afforded by a microscopic examination of the contents of the plugged catheter is truly noteworthy.

This detail in technique not only yields a diagnosis when other measures fail but it

serves also to emphasize the frequency of obstruction either partial or complete of the ureteral lumen. Incidentally it shows the value of the ureteral catheter in the re-establishment of drainage from the kidney. We have here a link in the evidence that recovery from pus infection of the kidney consequent to pelvic lavage is chiefly in response to opening the obstructed ureteral channel.

In this connection I am impelled to briefly express certain views on the question of pelvic lavage.

Irrigation of various infected organs and tissues has been quite generally discarded; we have learned the fallacy of irrigation for peritonitis also the evil which results from irrigation of wounds. In cultures of uteri removed after curettement I find more growth when preliminary irrigation has been employed than when this is omitted.

Moreover fluid cannot be instilled into the kidney pelvis without back pressure into the delicate kidney substance the danger of pyonephrosis is always present. But a few weeks ago I saw a pyelitis of pregnancy which resulted in pyonephrosis subsequent to careful pelvic lavage. Another case still more recently irrigated because of occasional pus cells and moderate numbers of colon bacilli from the left kidney now presents specimens loaded with pus and bacteria.

In those cases in which drainage fails even after the ureter becomes patent pelvic lavage enters consideration. In links of the ureter thick pus which will pass only when diluted pus locked in by friable adhesions lavage may cure upon occasion. As a rule however it must eventually be recognized and admitted that insufficient kidney drainage persistently present unrelieved by simple ureteral catheterization is a condition which demands surgical intervention.

If the ureter is not opened at once it will die and the bacteria will cause injury of the kidney and the patient may never reap the fruits of benefit.

## SUMMARY

1 In pus infections of the kidney in the event of failure to obtain urine upon ureteral catheterization, diagnosis is often possible through examination of material which plugs the end of the catheter

2 Kidney infections curable through pelvic lavage evidently owe their recovery to dislodgment of material which blocks the

lumen of the ureter Drainage of the occluded ureter can be established through the less dangerous procedure of simple ureteral catheterization When recovery fails to result after ureter catheterization and persistent employment of medical care, it is not to be anticipated that pelvic lavage will cure, the majority of such cases eventually require surgical relief

HÆMOSTASIS BY INTERPOSITION OF MUSCLE, FAT, AND FASCIA IN PARENCHYMATOUS ORGANS<sup>1</sup>

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THE purpose of this paper is to report the results of experimental work on the use of these tissues in stopping hemorrhage in such organs as the kidney and liver when other forms of hæmostasis are either impossible or undesirable.

We are concerned about two problems: (1) which tissue—muscle, fat, or fascia—is the best hæmostatic, and (2) what are the gross and microscopical end results of such interposition? Does the interposed tissue absorb, become fibrous, degenerate, obstruct blood capillaries, or allow formation of new blood channels? What in other words is its fate?

In splitting operations on the kidney for stone or tumor of the pelvis, or hæmaturia of unknown origin, bullet or stab wounds of the kidney, spleen or liver, or rupture of these organs, tears or large abrasions of the liver in the removal of the gall bladder, cysts or any other condition in which there is uncontrollable or serious bleeding, the need for an easily and readily obtainable and absorbable non-foreign hæmostatic is urgent. In search for such an ideal hæmostatic we have discarded all substances such as artificially prepared beforehand tissues of the human body or foreign substances such as sea sponges or other vegetable preparations so often advocated simply because they are not always and instantly available for use no matter when or

where the occasion demands. A substance, to be ideal, must satisfy these demands, and a substance obtained from the tissues of the patient himself is manifestly the most desirable.<sup>2</sup> In 1911 in an article on hæmostasis in surgery of the brain, Cushing recommends the use of pieces of raw muscle to control annoying hæmorrhage in brain work and speaks of this procedure as not being an unfamiliar one for apparently he and Horsley had independently come to employ it.<sup>3</sup>

Horsley (3) published a short article in 1914 on the further experimental use of this tissue. He explains the valuable action of muscle tissue on the ground that it possesses above all other tissues three requisites: (1) asepticity, (2) adhesiveness, and (3) thrombokenosis. The thrombokenetic process is stimulated in the tissue to which it is applied not only on account of the plasma exuding from the cut surface but also because of the thrombokenetic by-products (platelets, etc.) in the effused blood. The factor of adhesiveness is also an important one and it has been found experimentally that a piece of muscle

Even the fibrin advocated by Gray (1) was not considered because of the necessity of its beforehand preparation. We grant, however, that when brain surgery is being done always in a well-equipped hospital there may be an ideal hæmostatic for this particular branch of surgery.

The work of Cushing in this particular branch of surgery and his use of tissue as hæmostatic is (as well known) need further mention here. As this paper deals in no way with surgery of the brain, no reference is made to papers on this subject.

pressed firmly against wounds in a large vessel even the aorta in cats after it has become adherent will resist a pressure of from 60 to 80 millimeters of mercury.

Histologically the line of contact of muscle tissue against bleeding surface shows an excess of blood platelets and fibrin in considerable degree within 5 to 10 minutes after application. That the value of muscle lies largely in its thrombokinetic contents is shown by the fact that a piece of boiled muscle in which these elements are altered or destroyed acts very poorly as a hemostatic. Fascia and fat also fail to be as efficient because they lack both thrombokinetic elements and adhesiveness.

The rather definite opinion has been expressed by both Horsley and Cushing and others that muscle tissue is undoubtedly by far the most effective hemostatic of the three tissues under consideration.

From our operative work in the laboratory we believe this opinion should be somewhat modified. We would state that in general and probably in the majority of instances muscle tissue is by far the most effective and rapidly acting hemostatic when interposed in the bleeding substance of a parenchymatous organ but in moderate bleeding and in many cases of tears in the liver even down to spurs, an interposed piece of omentum will often check serious hemorrhage in a surprisingly rapid manner and in the kidney the same is true to a lesser extent of both fat and fascia but more especially of a thin strip of fascia. We can say therefore that muscle is probably the most effective hemostatic but fascia and fat will often work just as satisfactorily.

These substances are ideal hemostatics in that they are always readily and instantly available, are absorbable and interfere in no way with the healing of the tissues. They do not need to be removed later and wounds in which they are used can often be sewed up tight instead of being packed with gauze, therefore necessitating possible secondary hemorrhage from later removal of the gauze or the onset of sepsis with delayed convalescence dependent on a drained wound.

We have adopted the following procedure

in all not easily controllable hemorrhages in parenchymatous organs. First control all bleeding as far as possible by a firm gauze pack, while a suitable piece of muscle is being excised for application against the bleeding surface, remove gauze gently and quickly, apply the unwashed muscle to the area, hold it by firm gauze pressure until it becomes adherent and is anchored by a few interrupted stitches, remove gauze pressure gently and slowly. Should bleeding continue use more muscle if the whole bleeding area is not in contact with the first piece of muscle or overlap the first piece by a layer of fascia sewed down as firmly as possible to hold the muscle implant in place. Sew up with or without rubber tissue drainage as the case indicates.

In cases where it does not seem advisable to sacrifice muscle tissue use first fascia and secondly fat tissue. Whereas muscle tissue need rarely be sewed in place because of its adhesiveness, both fascia and fat must necessarily be sewed over or into the bleeding area as closely as possible. Of course the parenchymatous organs are extremely friable but we have found that with the use of No. 00 catgut or very fine silk a satisfactory application of these tissues can be made to the bleeding surface and that after a little gauze pressure over the implanted tissue organization in the underlying blood clot takes place so rapidly that on removal of the gauze, fascia and often fat tissue will be found quite firmly adherent to the raw area.

The following detailed account of our work will show definitely what method was employed and what can be expected and what the end results in tissue change were.

*Experiment 1* June 24, 1915. Dog. Intra-tracheal ether anesthesia. Right kidney delivered through lumbar incision, split to pelvis with rubber covered clamp on pedicle. Piece of quadratus lumborum muscle  $1\frac{1}{4} \times 1$  inches with some fascia attached, excised and interposed in upper two thirds of kidney incision. Muscle purposely rather jaggedly cut. Immediate hemorrhage checked. Muscle anchored to kidney with a few silk sutures. Kidney sewed up with No. 00 catgut. Wound closed without drainage. Moderate hematuria for forty-eight hours. Small sinus oozed serum for two weeks then healed. Animal sacrificed at the end of 88 days. Grossly it was impossible to tell where muscle had

were interposed. There was no bulging or depression over the scar. No signs of sepsis. No adhesions. Microscopically the muscle tissue of the insert stains rather lightly, is rather fibrous in appearance. There is practically no infiltration with polymorphonuclear leucocytes. Practically no degenerative changes in the kidney which stains normally except at the line of union of the two tissues where it takes the stain a little less darkly. In places fairly well marked line of demarcation between the kidney and muscle. In other places the ingrowth of connective tissue is such that there is close blending of the two tissues.

*Comment.* The interposed muscle acted as an effective plug to stop active hemorrhage and later became adherent to the cut kidney surface by the formation of fine connective tissue. There is evidence of a gradual change of muscle into fibrous tissue not yet complete at this time—three months. Insert has not been the cause of any degenerative changes in the adjacent kidney tissue.

*Experiment 2.* June 25 1915 Dog. Intratracheal ether anesthesia. Right kidney delivered through vertical lumbar incision. Large wedge shaped piece excised from upper pole and a similarly sized piece of quadratus lumborum muscle cut and interposed and held in place with a few No. 00 plain gut sutures controlling all hemorrhage except at very tip of incision where a persistent spurter required another piece of muscle to be placed over it to control bleeding. A layer of fat was then sewed over the line of suture and the kidney returned to its bed practically dry. A small urinary sinus developed on the sixth day but was closed in twelve days. Specimen taken at end of 30 days. Gross specimen showed solidly healed wounds in soft parts and kidney. A very small pea sized abscess in pelvis of kidney. Line of union of muscle and kidney solid. Very little evidence of operation. Microscopical section. Line of demarcation between two tissues more noticeable than in Dog 1 and more infiltration with leucocytes along line of union. Kidney tissue along line of union takes stain less well. Some slight ingrowth of connective tissue. Muscle more distinct stains more deeply and shows fewer fibrous changes. Sutures not encapsulated but their bed surrounded by leucocytes. No degenerative changes in kidney. Section after thirty days apparently shows an earlier stage of the healing process as would be expected. Apparently only beginning fusion between the two tissues. At this stage it would be hard to tell microscopically whether the implant was going to "take" or not. Overlying piece of fat not seen in section.

*Comment.* Implant of muscle checked hemorrhage. Seen at stage too early to show ultimate fate of graft. Was definitely adherent to kidney substance. Probably beginning to undergo fibrous changes. No degenerative changes in kidney tissue.

*Experiment 3.* June 28 1915 Dog. Intratracheal ether anesthesia. Right kidney delivered as previously. With a small trephine a ragged

bullet wound was simulated completely puncturing kidney. The hole plugged with muscle and a layer of muscle sewed over the wounds on either side of the kidney. Considerable hemorrhage until this muscle was well sutured in place. A layer of fat was then sutured over one side to prevent adhesions to a piece of protruding muscle. Rubber tissue drain sewed into skin. Wound healed July 6 1915 except small superficial sinus when drain was removed. Animal sacrificed after 84 days. A few adhesions around kidney but none in region of fat patch. There were encrustations along line of suture and dense scar where muscle had filled hole made by trephine. Microscopically section shows large blood clot partly fibrous in character especially at its line of junction with kidney tissue. Muscle stains moderately. Considerable infiltration with leucocytes both along line of union and in kidney tissue adjacent to this area. Line of demarcation between two tissues is indistinct and shows more firm organization of blood clot deeper in wound and more ingrowth of connective tissue into the crushed interspaces of the kidney. Muscle stains fairly well but is becoming fibrous in character and gradually losing its identity as muscle tissue. It has made a firm union with the lacerated kidney tissue which, however shows practically no degenerative changes.

*Comment.* Nearly three months after operation large muscle insert is becoming fibrous in character, has taken the place of the gouged out kidney tissue, has not apparently interfered with kidney function to any extent and has become firmly incorporated in its new situation.

*Experiment 4.* June 30 1915 Dog. Intratracheal ether anesthesia. High median abdominal incision. A piece of rectus muscle 2.5 x 1 inch excised and placed in warm salt solution. Sponge liver cut with knife 2.5 inches deep with profuse arterial hemorrhage. Muscle interposed and held in place with some difficulty (no assistant) by two silk sutures, but hemorrhage so profuse that wound had to be packed for 10 minutes. Dog nearly exsanguinated. Hemorrhage practically ceased when sewed up. No drainage. Animal died at the end of 48 hours from inanition. Autopsy showed no further hemorrhage had taken place after operation. There was fibrin everywhere around operation wound in liver with firm adhesions. Muscle was pale but adherent to liver firmly. No specimen taken as case too recent.

*Observation.* In order to secure the most prompt and most efficient action of the fibrin forming elements in muscle the edge to be approximated to a bleeding surface must be cut with a knife rather jaggedly and not crushed as with a scissors cut. Also in this case it is evident that some of the thrombotic elements were extracted from the muscle by its contact with the salt solution sponge.

*Experiment 5.* July 1 1915 Dog. Intratracheal ether anesthesia. Median incision in upper abdomen. Piece of rectus sheath 1.5 x 1 inch ex-



cised and placed in warm salt solution sponge wrung out nearly dry. Liver drawn down and held in operative field by mattress suture for traction (no assistant) an oblong piece of liver size of the fascial transplant excised with knife from upper surface fascia placed over this area and held in place by four silk sutures one at either corner. Vigorous ooze from denuded surface checked. Wound closed without drain. Autopsy after 14 days showed clean smooth surface where patch had been placed on liver. No signs of further hemorrhage or of sepsis.

*Comment.* Fascial insert checked immediate hemorrhage had become well attached to liver surface had not been absorbed and acted as an efficient hemostatic.

*Experiment 6* July 2, 1915. Dog. Intratracheal ether anesthesia. A 1.5 inch square piece of liver surface excised with profuse hemorrhage. Ragged piece of left rectus excised and sewed with four stay sutures of silk to raw liver surface. Bleeding stopped immediately and before wound was closed muscle seemed to be well adherent to liver surface. Animal died of pneumonia on sixth day. Autopsy showed omentum adherent just below line of suture on liver no signs of peritonitis. Site of operation covered with pale white layer of fibrin. Transplanted muscle soft rather pale and firmly adherent to raw surface of liver. Microscopical section shows muscle intact stains deeply and lies over small blood clot which in places is becoming fibrous. No signs of fibrous degeneration in muscle or ingrowth into liver. Liver shows intense leucocytic infiltration. Organization of blood clot firmly holding muscle to liver surface. Fibrous changes more marked on liver side of blood clot than on muscle side. Torn blood vessel walls shown. Suture not encrusted. Specimen too early to show definite fibrous changes. Small portion of a second section shows muscle in close contact with liver substance with fine fibrous changes and close adhesion of two tissues.

*Comment.* Muscle in early stage of implant is still intact shows few fibrous changes. Acted as efficient hemostatic on liver surface stopping immediate hemorrhage but section taken too early (6 days) to show other changes.

*Experiment 7* July 7, 1915. Dog. Intratracheal ether anesthesia. Liver pulled down and torn between fingers deep to active spurters and fat of round ligament held up into depths of tear by one silk stitch. Wound closed in layers with silk. Severe bleeding still present while sewing up. No drainage. Dog died under ether at a second operation on kidney nineteen days later. Autopsy showed no further hemorrhage no sepsis and omentum firmly grown to line of operation. Microscopical section of liver shows very slightly organized overlying thin blood clot. Fat of insert unchanged except for very slight fibrous change in some areas. No ingrowth of fibrous tissue into liver substance. Section kept too long in alcohol before cutting and is poor. Shows many artifacts.

*Comment.* The tissue of the round ligament acted as a fair hemostatic in the torn liver surface was microscopically adherent but showed no blending of the tissues or ingrowth. Section nineteen days after operation and marked changes in fat tissue not to be expected at this time.

*Experiment 8* July 9, 1915. Very small emaciated mongrel in poor condition from mange. Intratracheal ether anesthesia. Liver exposed gall bladder pulled down easy cholecystectomy bleeding on liver easily controlled with patch of right rectus muscle held in place by silk sutures. Wound closed in layers without drainage. Autopsy after 48 hours showed plain sized firm clot under site of operation no free hemorrhage. Muscle well incorporated in liver sulcus. Omentum well walling off area.

Microscopical section shown unencapsulated suture. Muscle pale and in cross section. Very little hemorrhage between muscle and liver. Line of union strongly infiltrated with leucocytes. No ingrowth. No change in muscle tissue. Stains deeply.

*Comment.* Section two days after operation. Too early to show any change except leucocytic infiltration. Muscle easily controlled hemorrhage at first but was not held sufficiently long or sewed sufficiently tight in place to act as entire hemostatic. Faulty technique.

*Experiment 9* July 26, 1915. Dog. Intratracheal ether anesthesia. Liver torn to spurters. Omentum sewed into rent and wound closed with out drainage in spite of rather free bleeding. Animal sacrificed after 56 days. Omentum firmly adherent to tissue some surrounding adhesions. No signs of late hemorrhage or sepsis. Section. Silk suture well encapsulated in young connective tissue no calcification. Fat tissue of omentum to certain extent absorbed and replaced by fine connective tissue. Line of adhesion to torn surface of liver shows many new blood channels. A moderate infiltration of leucocytes along line of union which is firm. No degenerative changes in liver.

*Comment.* Omentum largely replaced by fine connective tissue. Fat absorbed to a considerable extent. No degeneration of liver. Apparently omentum thus inserted forms a serviceable fibrous plug and acts as an efficient hemostatic.

*Experiment 10* July 27, 1915. Dog. Intratracheal ether anesthesia. Difficult cholecystectomy (no assistant). Ragged piece of left rectus forced into cavity with gauze pressure and on removal of gauze a layer of fat from the suspensory ligament was sewed over muscle to hold it in place. Immediate hemorrhage readily stopped. Animal sacrificed after 55 days. No signs of further hemorrhage. Omentum adherent to site of operation. Scar firm. No signs of sepsis.

Section shows line of demarcation between liver and implant sharp. No blending of tissues. Very slight leucocytic reaction. Implant firm in character. No absorption of liver tissue. Muscle

stains deeply Fat tissue shows some fibrous changes Sutures not encapsulated

*Comment* Wedge of muscle apparently acted as efficient hæmostatic without becoming permanently adherent to liver surface and has not become as fibrous as those inserts which have become fused with the surrounding tissue

*Experiment 11* July 22 1915 Dog 5 Intra tracheal ether anaesthesia Right kidney delivered, split to pelvis leaf like strip of fascia interposed and kidney sewed up with mattress sutures Considerable hæmorrhage before wound closed Many silk sutures placed along line of incision in kidney and fat laid over suture line Autopsy after 3 days showed considerable hæmorrhage around kidney which was probably due in part to tearing of soft parts, as kidney was very adherent and hard to deliver at operation Line of suture thinly covered with fresh fibrin Section shows marked leucocytic infiltration, especially at site of injury to kidney Fibrous tissue of fascia unchanged Stains strongly Is closely blended with kidney substance

*Comment* In this case fascia was not as successful in stopping hæmorrhage from a split kidney as was muscle in Experiment 1 but even in the short space of three days it became firmly adherent to kidney surface

*Experiment 12* July 30 1915 Dog 7 Ether anaesthesia cone method Right kidney split to pelvis Large slice of fat with some fascia interposed but with no checking of bleeding Even after mattress suture had been placed and tied the kidney bled profusely Dog etherized with cone and died on table

*Comment* Fat as a hæmostatic in severe hæmorrhage from the kidney is of little value It is difficult to keep in contact with the bleeding surface and has no fibrin forming qualities

#### CONCLUSIONS

1 The ideal hæmostatic in wounds of parenchymatous organs is interposed muscle tissue taken at the time of operation from the patient's own body

2 Such muscle in order to most effectively stimulate fibrin formation should be jaggedly cut with a knife and not crushed as with a scissors cut, nor should its hæmostatic properties be extracted by its contact with salt solution

3 Fascia and fat act to a more limited degree as hæmostatics fascia more than fat but both very much less than muscle In the liver however both fascia and fat seem at times to be very efficient hæmostatics

4 These tissues readily unite to the bleeding surface to which they are sewed and form a smooth solid scar

5 Microscopical examination of specimens removed at varying intervals after operation show in our series absence of sepsis a beginning transformation of muscle into fibrous tissue a partial absorption of fat and change into fibrous tissue no change in fascial transplants in practically every case a firm blending of the interposed tissue with the cut surface of the parenchymatous tissue the formation of new blood channels and no degenerative changes of any note

6 We conclude therefore that muscle, fascia and fat can be safely interposed into these tissues and after acting as immediate hæmostatics later undergo fibrous changes and form a firm union with the parenchymatous tissue

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## THE ADVANTAGE OF PLEURAL EFFUSION IN GIANT HYDATID CYSTS OF THE LIVER

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**H**YDATID cysts of the liver which develop almost exclusively in the thoracic region are relatively uncommon. The case which I shall report is very interesting because of its rarity and has prompted me to make a few suggestions which I trust will be duly weighed and submitted to clinical study.

A female, age 2, entered the general hospital of Chillan, Chile, December 1, 1905, with a large swelling involving the right side of the thorax, the hypochondrial and epigastric regions. Marked dullness reached upward close to the clavicle and the highest part of the scapula. In the epigastrium fluctuation could be easily felt. The swelling had commenced several years ago and had been accompanied by only a few disturbances. Loud rales could be heard. The temperature was normal. The findings were normal as evidenced by percussion and auscultation of the left lung. Auscultation of the right lung failed to reveal any vesicular respiration.

On December 30 the patient was operated on under chloroform anesthesia. A laparotomy incision was made at the outer border of the right rectus. After protecting the peritoneal cavity we injected a 2 per cent solution of formalin as advocated by Devl and Franke. By tapping an enormous quantity of clear fluid (2 liters) was easily withdrawn. The membranes were very thin and not well developed. As soon as the cavity was opened the air rushed through the wound. After performing the operation and before bandaging the patient we discovered both by percussion and auscultation that the lung had expanded to its normal capacity. Rales became almost inaudible.

A few hours after operation the patient became worse and expectorated an abundant frothy pink substance; pulse became weak and fast. Death followed the same afternoon after unsuccessfully injecting camphor and caffeine hypodermatically. Unfortunately, owing to the obsolete and defective hospital regulations, a necropsy was not performed and it was therefore impossible to confirm our diagnosis absolutely. Notwithstanding this fact we believe the clinical diagnosis of acute pulmonary edema is very probable.

Fluoroscopic examination would have been of great assistance in arriving at a correct understanding of the case.

Because of the enormous size of the cyst, the lung could not perform its function properly; the mediastinum was deviated to the opposite side; the

trachea was pressed upon producing rales and expansion of the left lung was considerably reduced. The sudden and complete drainage of the cyst permitted an equally sudden distention of the collapsed lung and the fatal congestion and edema which followed were unavoidable. As the heart had been handicapped in its function for so long it had become weakened and could not strive against the increased strain so suddenly placed upon it. I sum up the result was identical with that which occurs during or shortly after evacuating a recent pleural effusion.

The cyst, strictly speaking, was not an abdominal one; it could be classified as abdominal only by its point of attachment. Owing to the nature of its development the pulmonary edema was a purely thoracic condition requiring identically the same treatment as a pleural effusion. The thoracic dullness which extended to the clavicle and which was totally without thoracic vibrations we attributed according to our former experience to an accompanying effusion which in the above described case would have been of great help in preventing the fatal issue, since it would have checked the sudden distention and consequent edema of the lung. We are inclined to believe that very likely successful operations on enormous cysts of the liver owe their success to accompanying pleural effusion.

Very little mention if any is made as to the presence of pleural fluid in cases of hydatid cysts of the liver, especially when the cysts are found on the convex surface. Dieulafoy has called attention to this fact. The frequency with which pleural fluid is found is explained by the well known structural connection between pleura and peritoneum.

Pleural effusion would be of paramount importance not only as the explanation of the spreading of the pathological process but as an agent of the utmost significance in the treatment of the original disease. It has been wisely placed by nature to prevent harmful complications after the primary cystic cavity has been opened.

When effusion is not present, how can we supply it and obtain equally beneficial results? If our interpretation be correct it would be perfectly justifiable to induce an artificial

pneumothorax I shall not hesitate in the future to avail myself of this simple procedure in such cases

Another useful method would be to begin with fixation of the abdominal muscles and after three or four days to inject formalin and bring about a gradual evacuation in two or more sittings. This procedure is doubtless safe and methodic but it has the great disadvantage of bringing about secondary catarrhization

As to which one of these methods preference will be given, the future will decide

We have consulted the most important works on the subject but have failed to find the least reference to the question. The facts seemed to us to be so simple and their interpretation so easy that we do not hesitate to offer this brief resume in the hope that others who have better opportunities for seeing such cases will report their experience.

I wish to express my thanks to my friend Dr. Anibal Contreras, surgeon to the Woman's Department of the Hospital of Chillan, for the privilege of operating on and reporting this case.

## THE SIGNIFICANCE OF BLADDER SYMPTOMS IN THE DIAGNOSIS OF RENAL DISEASE

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THE relation of the bladder symptoms to renal disease is very similar to that of fever to infection or gastric symptoms to diseased conditions of the gall bladder.

No case of so called chronic cystitis should be so regarded without first having excluded renal infection. Although chronic cystitis in the great majority of cases is due to renal infection, this is by no means its only primary cause. Any bladder prostatic, or urethral obstruction which prevents the complete elimination of the kidney secretion is a potent predisposing cause of cystitis. We usually have a chronic cystitis with such conditions but without urinary obstruction. In the male primary chronic cystitis is of rare occurrence. We have found this quite different in the female. This is probably due to the easy route of ascending infection. Simple cystitis is much more frequent in the female hence we have found kidney infection, due to organisms other than tubercle bacilli, much more frequent in the female.

The renal conditions which are most frequently manifested in the bladder are (1) tuberculosis (2) pyelitis or pyelonephritis (3) lithiasis and (4) neoplasm.

### RENAL TUBERCULOSIS

It is safe to regard every case of persistent cystitis with pyuria, and especially in the young as tuberculosis of the kidney until a thorough investigation shows it to be otherwise. An early recognition of the disease is very important in order that secondary bladder infection which is very hard to cure may be avoided. The earlier the diagnosis the more favorable the prognosis.

*Symptoms.* Practically every case of renal tuberculosis is manifested in the bladder. These manifestations are much more marked in the male than in the female. Hematuria is also less frequent in the female for the same reason, that is complications interfering with the normal bladder function are more frequently found in the male than in the female. In tuberculosis profuse painless hematuria is occasionally seen before the appearance of any bladder symptoms. In such cases the lesion is most certainly in the kidney and without any local kidney manifestations. At such a time, however, firm percussion over the diseased kidney will elicit pain.

The vesical symptoms predominate during the whole course of renal tuberculosis.

and especially is this true in the early stages. In fact in its incipency a slight painless increasing frequency is the only noticeable symptom. This would not be recognized were it not for its annoyance at night. At such a time urinalysis will show a few pus cells, an occasional blood corpuscle and possibly a trace of albumin. Cystoscopy will show a congested ureteral opening with a few small ulcers about its orifice.

Tubercle bacilli can be found in the bladder urine in probably 80 per cent of all cases of kidney tuberculosis but to be thorough in our methods accurate in our diagnosis and safe in our treatment the ureters should be catheterized and guinea pigs injected with urine from each kidney. This will determine definitely whether one or both kidneys are tubercular. To remove one kidney when both are diseased would be disastrous.

Recently Petroff of Saranac Lake, New York, has described a new medium for the rapid isolation of tubercle bacilli from the sputum and feces. We are at present engaged in our laboratories in devising a technique for applying this method to the urine. It gives promise of obtaining a positive diagnosis by culture within one to two weeks, whereas the guinea pig test is hardly ever positive in less than three or four weeks. At present however we think it best to use a combination of the staining culture and inoculation methods.

Urological men practically agree that the infection is through the blood and lymphatics through the blood where there is no obstruction in the lower urinary tract and through the lymphatics where there is. Sweet and Stewart have shown that the lymphatics between the bladder ureters and kidney intimately anastomose and that infection can readily be transmitted through them. This I believe is why kidney infection is more frequent in the female than in the male and especially the pregnant female. It is said to occur in the latter in about 20 per cent of all cases. Here we have the lowered resisting power, the frequent bladder infection and anastomotic lymphatics.

The cystitis due to organisms other than tubercle bacilli is less severe than that which occurs with tuberculous. Clinically this knowledge is of value in differentiating a simple from a tubercular infection. However we may have a mixed infection. We should always be suspicious of tuberculosis where we have areas of ulceration in the bladder. In such cases the above combined test for tuberculosis should be used.

We not infrequently have general infection of the kidneys with practically no bladder infection or symptoms. I have recently seen several such cases but all of long standing. The tissues seem to become accustomed to the presence of the bacteria and as a result they produce only a slight reaction. It is also said that the symptoms produced by hematogenous infection are more marked than those due to lymphatic ascent.

#### PYELITIS OR PYELONEPHRITIS

These two conditions are so closely associated and their symptoms so similar that we can discuss them as the same condition in so far as the bladder manifestations are concerned. Frequency of urination is present in about 75 per cent of the cases of simple infection while marked cystitis is found in only about 16 to 18 per cent.

The local kidney symptoms are also less severe in a simple pyelonephritis than in tuberculosis. The bladder symptoms grow less severe in the former and more aggravated in the latter. The proportion of the cases of cystitis resulting from renal infection is greater in the male than in the female. This again is due to the easy elimination in the female. Hematuria is present in 40 per cent of the cases of kidney infection. (In hematuria due to a simple pelvic infection nitrate of silver irrigations through the ureteral catheter give wonderful results.)

In addition to the clinical symptoms of pyelonephritis it is necessary to obtain pus from urine secured by ureteral catheterization in order to make a diagnosis. The amount of pus thus obtained varies in pro-

portion to the activity of the infection. Patients with a sensitive bladder and practically no microscopic findings in the urine will often show bacterial growths from urine obtained by ureteral catheterization.

Bilateral infection occurs in about 70 to 75 per cent of the cases of simple kidney infections. It occurs much more frequently in the right than the left when unilateral.

The activity of a chronic renal infection varies considerably. At times it is almost dormant. In such cases the only symptom noticeable is a slight frequency of urination. Here pyelography is of great advantage as well as the phenolsulphonaphthalein test.

Pyelography shows ureteral and kidney pelvic dilatation and differentiates that due to inflammation from that due to back pressure. The phthalein output gives the kidney functional activity. This is in proportion to the extent of parenchyma involvement. In the simple pyelitis of course the output will be normal but in a pyelonephritis it will be diminished in proportion to the extent of the infection. The normal kidney function may be impaired as a result of a chronic parenchyma infection when there is practically no pus in the urine obtained by ureteral catheterization. In such cases a bacteriological examination will disclose not only infection but also the nature of the infection.

#### LITHIASIS

The clinical picture of lithiasis is so intimately associated with bladder symptoms that a distinct radiographic shadow in the kidney or ureter would hardly be interpreted as that of stone without bladder symptoms. This is certainly true at the beginning of impacted ureteral stone.

Urinalysis may or may not reveal evidences of kidney stone. There is always more or less infection accompanying kidney stone and of course its manifestation in the urine is in proportion to the activity of the infection, the size of the stone, and its location. A stone located in the kidney pelvis will produce greater frequency than when it is located in the kidney paren-

chyma. Blood and pus are also more constant in the urine when the stone is in the pelvis. Hematuria is increased by motion and especially following violent exercise. I believe this is more constant if the stone is in the kidney pelvis.

In addition to the bladder manifestations and the usual clinical tests for kidney stone the ureteral catheter and X ray are indispensable if we are to be accurate in our diagnosis.

#### NEOPLASM

There are practically no bladder manifestations of the kidney neoplasm except hematuria and the bladder symptoms accompanying ureteral occlusion with blood clot. Hematuria may be profuse as in papilloma of the kidney pelvis or it may be so slight as to be detected only by microscopic examination of urine obtained by ureteral catheterization. When the hemorrhage is profuse it may be intermittent and accompanied with attacks of colic as well as frequency of urination. These are produced by the ureters becoming occluded with blood clot.

In hypernephroma about the only symptom complained of is hematuria. Here again the ureteral catheter, phthalein output, and X ray pictures are necessary to make an accurate diagnosis.

#### CONCLUSIONS

1. Persistent frequency of urination is only a manifestation of a pathological condition somewhere in the genito urinary tract.

2. Chronic frequency, without urethral obstruction, prostatic or seminal vesicle inflammation means renal disease in practically every case.

3. The bladder manifestations of the various pathological conditions of the kidney are so similar that it is only by a close observation of the clinical symptoms and by the use of the most approved laboratory methods that we are able to differentiate not only between bladder and kidney lesions but also between the various pathological conditions of the kidney.

## THE CLINICAL COURSE OF CANCER IN THE LIGHT OF CANCER RESEARCH<sup>1</sup>

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**I**n attempting to deal with the clinical course of cancer in the light of cancer research one immediately realizes how little the discoveries of the investigator in this field have come to influence the clinician. This is an unhappy circumstance for in the last eighteen years our knowledge of the cancer problem has been greatly advanced. The time has come when some of the advances of cancer research should become the possession of the clinician and should be a part of his reasoning and guide him in the consideration of clinical cases. No doubt the clinician has properly felt that modern cancer research has as yet produced but little of practical value and so far as revolutionary methods of treatment or diagnosis are concerned such a view is at least in part justifiable.

There are many ways in which the classical clinical picture of cancer should be modified by the discoveries in this field in the last two decades. Let us choose for consideration the immunity to cancer. Our knowledge of this subject has been gained by experimental studies with the smaller animals. Can we apply our knowledge of this phenomenon to the field of human cancer? To do this we must understand that our conception of the cancer problem and the group of diseases known as malignant has been greatly advanced in the last few years and that much of the vagueness and uncertainty of the earlier period of research has been cleared away by a better understanding of the problem itself.

First of all the intensive study of types of cancer in the lower animals has shown us conclusively that cancer is not one disease but a great group of diseases. Of some of the neoplasms in the lower animals we have learned much. In one group the chicken sarcoma, we have learned the cause and in certain other groups like the round cell sarcoma in the dog the spindle cell sarcoma of the rabbit the endemic sarcomatosis of

the nasal passages in horses and cows described by Stenstroem carcinoma in the esophagus and stomach of rats by Fibiger and that interesting disease known as carcinoma of the thyroid in the salmonoid fishes our knowledge of the probable etiology is well advanced. With more exact knowledge the identity of each one of these diseases has become more pronounced and so we know of a certainty that the different types of cancer which we have viewed collectively must now be studied individually. This has enormously broadened the cancer problem. It precludes the possibility of a sudden discovery which shall solve the whole problem readily but it affords us the certainty that by studying its component parts and by the continuation of the progress which research has made in the past we shall ultimately come to understand that great group of diseases which we have recognized as cancer.

Investigators of cancer have worked with many types of neoplasms in the lower animals. We may choose the subject of immunity as affording a phenomenon which is common to all of them. We now know that, when the disease is transplanted there is aroused in the organism of the affected individual a resistance. This resistance is greatest in the earlier stages of the disease. It is the force which holds the disease dormant or by its loss permits its progress and in some instances it is the force which succeeds in overcoming the disease and producing those rare occurrences of spontaneous recovery which have been observed experimentally and naturally in animals and occasionally in human beings.

In 1904 the workers in Buffalo had the good fortune to observe that mice inoculated with mouse cancer would sometimes develop tumors even of considerable size that the tumors would then retrograde and disappear leaving the animal immune to further inoculations. This fact has been repeatedly

observed in various types of tumors in lower animals in all the laboratories of the world engaged in cancer research. It was also found that the chance of spontaneous recovery in inoculated animals was inversely proportional to the duration of the disease and the size of the growth meaning that the chances of recovery are greatest in the very beginning of the disease. This observation is of great importance to the surgeon for the reason that he is constantly endeavoring to secure cancer cases early and it explains why surgical interference in the very beginning of the disease is so much more successful than later. We were able to collect authentic cases from the literature which showed that in the earliest stages of the disease even when all the growth was not removed by the surgeon, in some instances what was left retrograded and the immune forces were sufficient on the removal of the greater portion of the growth to overcome the rest.

In the first observations in 1904 we were able to demonstrate under the conditions which then obtained in the mouse tumor which we were studying evidences of a passive immunity. We found that the blood of mice which had recovered spontaneously had an inhibiting effect upon the growth of tumors if the animal was treated when the inoculated tumor was small. The blood of recovered animals had an inhibiting effect upon the rate of growth of more advanced tumors so that there was a time when all the treated animals were alive and all the controls were dead. Furthermore it was shown that in the early stages after inoculation the immunity aroused by the growth of the primary inoculation was sufficient to prevent and for a considerable period, a successful secondary inoculation. This showed the existence of concomitant immunity. For the purpose of further demonstrating the existence of this concomitant immunity experiments were carried out to determine how it might be injured and it was found that a mouse with an inoculated tumor which was growing but slowly or was nearly stationary could have its immunity exhausted by bleeding the animal. Loss of blood either as a substantial hemorrhage or the loss of two or

three drops on successive days, would result in a sudden acceleration of the rate of growth of the tumor with a more rapid fatal termination than in the control animals. The existence of immune forces which check the rate of growth of neoplasms can be traced in spontaneous tumors in animals and on consideration the clinician will readily see that this offers an illuminating explanation of the variations in rate of growth and long periods of latency in clinical cancer in human beings.

Having determined that loss of blood injured the resistance it naturally occurred to us to determine the effect of anesthetics upon the rate of growth, and we found that inoculated tumors in animals which were chloroformed for a considerable period, or for short periods on succeeding days, developed a much greater rapidity of growth than control animals. In this connection chloroform was found to be more injurious than ether.

Three years ago Dr Tyzzer working with carcinoma of the breast in the Japanese waltzing mouse carried out an elaborate series of carefully controlled experiments which showed that operations upon inoculated tumors accelerated the rate of growth of metastases or of secondary implants. In these experiments he used ether anesthesia, and they were of course associated with the usual loss of blood attendant upon such operations.

These observations are surely of importance to the surgeon. What surgeon has not occasionally encountered a favorable looking cancer case in which the growth has progressed but slowly which after a radical operation with anesthesia suddenly recurs and grows at a greatly accelerated rate terminating rapidly in death. Every surgeon has had the experience of seeing cases which he wished he had not operated upon in that the operation did not prevent recurrence and after prompt recurrence the progress of the disease was greatly accelerated. Experiments are now being conducted to determine whether nitrous oxide anesthesia is less injurious than chloroform or ether. In the same article Dr Tyzzer showed that in the Japanese waltzing mouse tumor which animal possesses a complete susceptibility to the



tumor and in which immune phenomena are nearly absent by massaging the tumor he was able to produce metastases almost at will even in the earliest stages of the disease. In two other propagable tumors, one a cancer of the breast in a mouse the other a sarcoma in a mouse such massage during the early stage did not produce metastases. That in many primary human tumors the immunity is sufficient to prevent the metastases may be deduced from the observation of Goldmann who showed in 1897 by a careful study of cancer of the breast in human beings that cancer cells enter the circulation in many such instances without the production of metastases.

The nature of the immunity to cancer has for ten years been the subject of active discussion. The so-called atreptic theory for cancer immunity advanced by Ehrlich has been generally disproved by investigators. Our original observation that there were probably immune forces in the blood serum of recovered animals did not meet with prompt or wide acceptance because of the constantly changing conditions which surround such experiments when carried out on living animals.

With the round cell sarcoma of the dog Crile and Beebe were very shortly able to demonstrate the existence of immune bodies in the blood of recovered dogs by transfusing such blood into animals with tumors observing prompt regression and recovery in repeated instances. Lewin in Berlin succeeded in demonstrating the existence of immune forces in the blood of recovered rats in a spindle cell sarcoma of the rat and von Dungern found marked evidence of passive immunity in the spindle cell sarcoma of the German hare. Other investigators working with different tumors and probably under unfavorable conditions of experimentation have failed to repeat the earlier experiments with the mouse tumors. Clowes in the Buffalo laboratory in 1904 mixed the blood of recovered animals with a given measured amount of mouse cancer before inoculation and was able to show that under these conditions the number of successful inoculations was markedly reduced. Bashford found that mouse cancer cells inoculated

into the circulation of spontaneously recovered mice failed to produce tumors and disappeared and Tyzzer has recently shown that by treating the graft of a Japanese waltzing mouse tumor with the blood of recovered white mice he was able to produce in the immediate neighborhood of these graft the marked cellular reaction which is found in resistant animals. Weil who some years ago carried out a series of experiments with the Buffalo spindle cell sarcoma of the rat and was unable to convince himself of the existence of immune bodies in the blood has just reported at the meeting of the American Association for Cancer Research on May 8 1916 that by modifying the experimental conditions he has now been able to demonstrate to his satisfaction the existence of definite immune forces in the blood of spontaneously recovered rats.

It is not necessary for us to attempt to consider the exact nature of this immunity but we might point out that the immunity is probably specific for each type of cancer and that in the chicken sarcoma of Rous where this investigator has been able in three different types of sarcoma to filter out a virus he has been able to test the question which has long been before investigators whether the immunity to cancer is directed toward the cause of cancer or is a cytolytic action against the cells and Rous has been able to show that a chicken which is immunized against the spindle cell sarcoma is not immune to the virus of the osteochondrosarcoma although both of these tumors are of connective tissue origin.

It may well be asked to what extent we may apply these facts so laboriously wrung from experiments upon animals to cancer as it exists in human beings. Some of these data must immediately awaken sympathetic response in the mind of the physician and it is not for me to point out the application but it would greatly interest any clinician to read again a very suggestive article by Petersen in the *Beitragte zur klinischen Chirurgie*<sup>1</sup> in which he postulated the existence of immune forces in human cancer cases. Petersen's theories were deduced from a careful

and exact study of cancer in human beings, and preceded by two years the first conclusive proofs of immunity to cancer in animals. He thought of the possible antibodies as being of a cytolytic nature but such a conception was at that time very natural.

Marked advances have been made in the last few years in our understanding of the nature of this immunity to cancer. It was shown early in experimental work with animals that among normal tissues the spleen was particularly efficacious in immunizing animals against inoculation with propagable cancer. Bidre and Apolant immunized animals with normal spleen tissue and Braunstein showed that by removing the spleens of resistant animals they became susceptible but the definite demonstration that the immunity to cancer has its origin in the splenolymphatic system which is the seat of all known immunities to infectious diseases or non specific substances was not conclusively demonstrated until Murphy, by an ingenious series of experiments showed that in chick embryos the growth of normal chicken spleen would prevent the growth of neoplasms inoculated into the embryo which in the absence of an accompanying growth of spleen tissue, would grow readily. He also showed that neoplasms which could be successfully ingrafted in the chick embryo could be made to retrograde by the subsequent implantation and growth of normal chicken spleen and following these facts he found that by injuring the spleen in resistant mice they could be made susceptible to the growth of mouse cancer or even of alien tumors so long as the injury to the spleen remained and that with the regeneration of the splenolymphatic system the immune forces were re established. Hence it is now definitely understood first through the early experiments in Buffalo with subsequent confirmation that the immunity to cancer is evidenced by the existence of immune forces in the blood. Second the site of this immunity is in the splenolymphatic system where all the known types of immunity take origin.

Reasoning from the experimental demonstration of these forces in inoculated animals to the existence of such forces in animals

spontaneously suffering from cancer and to the phenomena observed in the clinical course of cancer in human beings we have before us the logical explanation of many vagaries and ill defined phenomena in cancer in man. We understand now why surgical interference is so successful in the very first stages of cancer and why it is so unsatisfactory in the later stages. We should be cautioned against tedious and long drawn out operations using chloroform or ether as an anesthetic and associated with marked loss of blood and we can offer certain evidences to show that X ray and radium exercise their curative effects through the immunity.

In 1905 in Buffalo we observed that tumors which were held stationary by X ray treatments could be made to grow by bleeding the animal exactly as in the case of tumors stationary in the natural course of the disease. From this we reasoned that X ray and radium operated through the immunity. Recently Murphy has conclusively confirmed this view by showing that spontaneous mouse tumors if removed and given the X ray treatment, can be re inoculated into the animal with almost the same percentage of success as where no treatment is given. (In spontaneous tumors the primary tumor can be removed and portions of it can be reimplanted in practically 100 per cent of cases.) Then Murphy showed that, if the tumor was removed and the X ray treatment was given to the mouse the reimplantation of a fragment of the tumor almost invariably failed showing that the animal had been made resistant by the X ray treatment. From this he properly reasons that the therapeutic effect of the X ray or radium is in large part secondary and not alone the result of the direct action of these agents upon the tumors.

An understanding of these facts enables us to explain why in many instances a few treatments with the X ray or radium produce marked benefit and then suddenly without any apparent cause such treatments lose their effect and the tumor grows rapidly in the face of the treatment. Knowledge of the existence of immunity to cancer affords us the basis of research to determine the exact modus operandi of X ray and radium and

will undoubtedly enable us to secure with certainty the beneficial results of these agents in those cases in which the existence of a sufficient immunity permits successful treatment.

These are some of the ways in which cancer research should assist the clinician to a better understanding of the clinical course of cancer. The outlook of cancer research and the prospects of practical help for the clinician are many times brighter today than they were eighteen years ago when experimental cancer research may be said to have been founded.

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## THE CONSTITUTIONAL FACTOR IN GYNECOLOGY AND OBSTETRICS

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**I**N this contribution on the constitutional factor in gynecology and obstetrics certain principles will be presented which are demonstrated by biologic human clinical pathological human intestinal pathological comparative pathological or by experimental teratological evidence or by a combination of such evidence.

A recognition of these principles will greatly enlarge the powers of the practitioner of medicine (1) By enabling him to obtain a comprehensive understanding of the biologic relations of medicine (2) by increasing his powers of diagnosis (3) by increasing his powers of prognosis (4) by enabling him to avoid many current errors in therapy both operative and general (5) by increasing his powers therapeutically through enabling him to substitute general nutritional and developmental therapy when indicated for local therapy currently employed and thus to effect the cure instead of the amelioration of his patient's condition (6) by enabling him to give scientifically based advice as to methods of living both positively and negatively when the biologic type of the patient is recognized to promote the development of environmentally arrested patients and to enable them to maintain their health by

living within their particular potential or capacity to produce energy instead of attempting to live as is physiological for typical individuals but which will cause disease in the arrested or hereditary and environmental devolutes.

Since Marion Sims made practicable an operation for the cure of vesicovaginal fistulae gynecology has more and more, developed as a surgical specialty and while gynecologists have elucidated the morbid anatomy of their specialty their attention has been chiefly fixed upon the perfecting both of the details of aseptic surgery and of the technique of the various particular operations which have been originated for either the relief or the cure of the diseases and of the morphological anomalies of women. During the same period development in obstetrics has also been largely surgical in its character. So much is this true that gynecology and obstetrics have both tended to become surgical specialties and the drift in practice in the United States has been toward the abolition of the specialty of gynecology and the taking over of the duties of the gynecologist by the general surgeon. The writer has never been in sympathy with this tendency in America but has, on the other hand felt that the

German practice of combining gynecology and obstetrics has much to recommend it especially from the standpoint of teaching and of theory. He is willing to grant that the practical difficulties which exist in the United States render such a combination of duties relatively impracticable from the financial standpoint, with us but is not willing to admit that the general surgeon who has not served an apprenticeship in an obstetrical hospital and who has not been trained as a neurologist—and especially who has not been trained as a psychic analyst and diagnostician—is capable of making discriminating diagnoses in the department of gynecology and as a consequence is not capable of properly discriminating between conditions requiring an operation for their cure and those which are merely incidental to constitutional manifestations or to morbid symptoms referable to the nervous glandular or the hematopoietic systems.

The unfortunate result of this lack of discriminating insight on the part of general surgeons is the performance of a great many unnecessary and therefore harmful operations by them and by general practitioners doing surgery. This lack of training and of insight into the nature of the diseases of women which it occasions is the cause of a smaller number of sins of omission.

The sins of commission have been for the most part in the field of the ptoses and of the various forms of arrest of development of the uterus. Because of the hysterical craze to perform nephropexy which followed the appearance of the early papers of Edebohl and of the writer in the nineties when a large proportion of general surgeons operating from a morphological basis stitched up all kidneys they could feel, there followed a reaction whereupon all those calling themselves conservative stitched none. This operative craze was almost as widespread as that of dilatation and curetting for arrest of development of the uterus—and as baseless. It is true that patients with a hypoplastic constitution and also those having long waists, almost invariably have low placed and quite movable kidneys, this status of the kidney in such constitutions is quite normal

and therefore produces no morbid symptoms. Nevertheless in the minority of instances perhaps 10 per cent, when such individuals make overdrafts upon their nerve force by doing more than their capacity for work permits nervous exhaustion loss of fat, and a more atonic state of the fibrous and other tissues ensues with increased movability of the kidneys and in certain cases torsion of the kidneys and consequently a relative intermittent obstruction of either or both the renal veins and ureter follows with congestion of the kidney and at times grosser lesions as a consequence. In such cases nephropexy is indicated not to cure the general nervous symptoms due to nervous exhaustion in hypoplastic individuals but to relieve the local morbid condition due to local causes and conditions. The same state of facts obtains with reference to the other ptoses both abdominal and pelvic and this is also true of other conditions which are like the ptoses usually due to environmental hypoplasia or arrested development due to faulty environment.

Sins of commission and of omission are not peculiar to either the general surgeon or to the general practitioner. Those of us who have been in the profession long enough to remember the status of practice in the eighties and nineties will recall that those gynecologists who are euphemistically classed either as enthusiasts or as radicals have an equal or a greater number of sins of commission to their discredit. This form of enthusiasm and of radicalism is due either to lack of discriminating judgment or else to a poor development of the ethical inhibitory apparatus.

Prior to 1900 the minds of gynecologists were largely taken up with the development of the details first of antiseptic and second of aseptic surgery until the principles and practice of aseptic surgery were thoroughly worked out, including the installation of suitable apparatus for the preliminary sterilization of instruments dressings and the other paraphernalia of operations. The character of the operative technique of that period is best described as meticulous and the mental concentration involved in performing many operations used up about all of the mental

acity of the gynecologist so that he had  
le intellectual energy for the study of  
hological problems and none or almost  
e for the study of the biologic basis  
only of gynecology and obstetrics but  
of medicine in general. In his student  
s he heard the professor of anatomy make  
e reference to comparative anatomy as  
laining some of the more recondite prob-  
s of human morphology also either in the  
tomical or in the obstetrical lectures a  
critical knowledge of the more elementary  
s of embryology were learned and cer-  
n of these facts were employed in the ex-  
nation of anomalies met with in surgical  
ctice. The younger men in the profession  
e had a course in elementary botany and  
logy and have received some training in  
logical philosophy which knowledge was  
loma part of the medical training of their  
ers in America.

also it is a regrettable fact that the Vir-  
w school of pathologists has turned its  
ention almost entirely to the observation  
description of detailed phenomena or  
s and like the founder of the school has  
ned attempts to interpret the mass of  
s observed by hypotheses as had been  
custom in the medical profession and in  
broader school of natural philosophers  
ughout past ages and this is a perversion  
he teaching of Bacon as to the application  
the experimental method of arriving at  
th. Virchow and his followers condemned  
it they call theorizing and at least reluc-  
tly those whom they call theorizers—  
rly oblivious of the truth enunciated by  
ificus that undigested facts lead to  
fusion.

ortunately all pathologists and physio-  
cal chemist were not obsessed by the  
icious portion of the teaching of Virchow  
also of his followers otherwise little or  
progress would have been made in medi-  
e as to the theoretical interpretation of  
baid phenomena since Virchow's orlat-  
eured above the medical horizon. Such  
as Pasteur, Lister, Koch, Metchnikoff,  
Ehrlich have followed the methods of  
Fathers to digest facts and to extract  
truth from them or to reduce observed

phenomena to principles through their cor-  
relation and interpretation.

The unfortunate consequence of this teach-  
ing and practice of the Virchow school was  
the amassing of such an enormous mass of  
unexplained and largely useless data that no  
human mind could remember them and  
should one accomplish the Herculean task  
he would inevitably have suffered with mental  
indigestion from having crammed his mem-  
ory with such a mass of uninterpreted facts.  
This state of affairs was well set forth by  
Adam in the preface to the first edition of  
his masterly treatise upon human pathology.

The further and even worse consequence  
of the obsession of the profession with refer-  
ence to the importance of this teaching of  
Virchow was that the lessons of the ages  
from the days of Hypocrates down were  
largely forgotten. The minds of so called  
scientific clinicians were so exclusively taken  
up with speculations upon the nature of the  
minute morphology of the morbid processes  
constituting disease and as to how these would  
appear if seen under the microscope that  
they have largely passed by the fact  
that these reactionary processes are only a  
small part of the problem set before them for  
their solution. The doctor's problem has  
to do with the human being who is sick,  
primarily and it has only secondarily to do  
with the patient's sickness.

Disease is the reaction of an organism to  
an environment sufficiently unfavorable to  
produce either local or general discomfort  
or other disordered functions or death.  
The morbid process is the reaction to safety  
of the organism in general or *in loco* against  
the unfavorable environment in its effort to  
get rid of the influence of the pathogenic  
agency which analysis shows in some pro-  
toplasmic poison introduced into the organ-  
ism or which fails of proper elimination  
when generated within. The type of reac-  
tion in degree if not in kind is due to  
the type of the organism or the constitu-  
tion. This factor in medicine which consti-  
tutes the major portion of the doctor's prob-  
lem when confronted as a practitioner  
with disease has been almost wholly lost  
sight of and has not been taught to medical

students since the profession became obsessed with the teachings of Virchow and this has resulted in the spread of therapeutic nihilism. It is only in the immediate present that medical works are appearing which indicate the beginning of a reaction from the fallacious portion of the teaching of Virchow and a return to the point of view of the Fathers in Medicine. In its modern form this reaction is called the biologic or genetic concept of medicine.

Intelligent and careful observation of the character of febrile reactions in the human family in the past had enabled the Fathers to differentiate between three types of fever: (1) The sthenic type (2) the asthenic type (3) the nervous or irritable type. It was upon recognition of the type of the fever that special therapy was based. These three types of febrile reaction correspond with the three great groups of human beings from the biologic standpoint:

1. Those coming of sound stocks and having a good constitution or typical individuals or devolutes

2. Those coming of stocks constitutionally defective in one or more of their organs or systems of organs which states were formerly described as diatheses or dyscrasias or hereditary devolutes

3. Those whose ontogenesis has been arrested by unfavorable environment in the preconceptional germinal embryonal foetal or post natal — infantile puerile adolescent, or the youthful periods of ontogenesis. The arrest manifests itself either as an absent part or as a morphological malformation in those in whom the protoplasmic poisoning of the developing organism due to disease in the mother occurs during the early weeks of pregnancy when organs and systems of organs are being laid down whereas when this poisoning occurs later in pregnancy after the systems of organs have been developed and also when it occurs in post natal life its consequences are manifest in a general instead of a particular arrest of growth and in a lessening of the potentiality of the organism to develop full energy. This latter state may likewise be due to poisoning of the ova and of the spermatoblasts and sperma-

tozoa prior to conception during the dual life of a human being in the environment of the ovary and of the testis respectively. Those belonging to this group are environmental hypoplastic devolutes.

4. A mixed subgroup having both hereditary and environmental defects — both hereditary and environmental devolutes.

The *sthenic type of fever* is the reaction typical of those having sound constitutions when suffering from a marked local or general infection. The *nervous or irritable type of fever* is that characteristic of hereditary devolutes and more especially of those having an inherited nervous diathesis. The *asthenic type of fever* is that characteristic of environmental hypoplastic devolutes under similar conditions. The *mixed or nondescript forms of fever* characterize the reactions of those belonging to the fourth mixed or subgroup of both hereditary and environmental devolutes.

The writer had the good fortune to begin the study of medicine prior to the obsession of the profession by the fallacious portion of the teachings of Virchow when the wisdom of the Fathers of Medicine was still taught to medical students. It was of great interest to him to realize the insight of the older clinicians in their classification of 'temperaments' and of constitutional reactions to infection when after working upon the subject from 1886 until 1908 he realized the nature of environmental constitutional hypoplasia, and the relations of bad environment in ontogenesis and of heredity to the production of the two great types of devolving human beings as set forth in his papers entitled 'Hereditary Hypoplasia in Man Due to Degeneracy' and 'The Law of Degeneracy in its Relation to Medicine.'

When these papers appeared they attracted but little discussion and most of that was unfavorable. This fact was, at first difficult of comprehension but upon reflection its explanation was seen to be in part that more especially the paper on 'Hypoplasia' was poorly written and in part that doctors in general know little of biology and care less

They have been satisfied to follow blindly the lead of Virchow who according to Haeckel became blind himself quite early in his career and became a reactionary. Those who had received a biologic training had been trained in the school of Weismann whereas these papers were written in accordance with the views of evolution of Lamarck Darwin Haeckel and the paleontologists. Hence among those having had zoological training they encountered prejudices arising out of the controversies between the neo Darwinians and the Weismannian group of zoologists. Thus the work when presented was stillborn.

It became evident that it would be necessary to study the biologic relations of the human problem which had been worked out in the light of the teachings of Weismann and of Mendel which study occupied nearly four years when it became feasible to restate the nature of environmental congenital hypoplasia discriminatingly and to point out how that although congenital it is not hereditary but is due to poisoning of the ova (or the spermatoblasts) prior to conception or to poisoning of the impregnated ovum during various stages of embryonic development and also that constitutional hypoplasia or arrest of development can arise at any time during post natal life from bad environment. In this way a sharp distinction can be drawn between defective constitutions of *strictly hereditary origin* and those having a *strictly environmental causation*. But the latter may become hereditary in the future generations or the descendants from such parentage i.e. an individual having arisen from an ovum poisoned in the ovary of the mother or from a spermatozoon poisoned in the testis of the father will not be able to produce typical offspring. It was also shown that a large mixed or subgroup exists exhibiting both morphological and functional defects — some of hereditary and some of environmental origin. It was at the point of Affection of the Ovum (Weismann) that the two great groups of devolutes were brought in due relation the one to the other and thus the difficulty arising from the assertion of the Weismann school as to the impossibility of inheriting acquired characters was avoided.

It was learned during this time through the study of antenatal pathology in the human and the study of experimental teratology that both clinical pathological and experimental laboratory evidence is available to demonstrate the correctness of the concept of environmental constitutional hypoplasia or environmental degeneracy in accordance with the strictest requirements of the Virchow school. As Professors Mall and Stockard put it: All terata not dying *in utero* are born alive and those that live to mature years continue to be terata. These manifest every degree of defect from a mere incapacity to develop full constitutional energy — *asthenia uni cruralis congenita* or constitutional inferiority or the broader concept of infantilism — to gross monstrosities is the other extreme with special deformities such as one eyed terata spina bifida cleft palate harelip club foot infantile vagina uterus etc. and also the greater degrees of asthenia and varying special defects of organs and systems of organs as diathetic types of environmental defects between the two extremes already mentioned.

Experimental teratology has now reached the degree of development in its principles and methods that it is possible to produce 90 per cent of certain forms of terata to order by means of the poisoning of fish eggs upon different days in their development by special poisons applied in prescribed strength.

The application of these principles to gynecology and obstetrics in explaining the nature of the relation of the particular type of constitution of a patient to disease is apparent.

The diseases and morbid states which constitute gynecology fall into a few groups:

1. Infections (a) of the mucous surfaces of the genito urinary tract (b) of the peritoneum and of the tissues cellular glandular and muscular contiguous to both
2. Malpositions and more especially ptoses of the pelvic and abdominal viscera
3. Tumors (a) benign and (b) malignant
4. Lacerations
5. Hypoplastic states of organs or systems of organs arrested in their development a few from hereditary causes and most of them from environmental causes

6 Functional psychic and somatic disorders due to maladjustments of sexual life

The above grouping constitutes the whole of gynecology in principle

Most of the above morbid states are atypical morphological phenomena *they are not morbid entities or diseases but are merely phenomena or episodes in the ontogeny of a constitutionally hypoplastic individual* whose development has been relatively arrested. The morphological facts in connection therewith include a persistence of foetal infantile and puerile positions and conformations of the organs concerned such as an infantile or adolescent uterus ovaries and fallopian tubes the pelvic and the low placed kidney in infantile puerile and adolescent forms and positions of the gut and also puerile or childish or adolescent morphological forms of the entire trunk, including more especially the chest and abdomen which characterize the hypoplastic constitution. Also defective because arrested nervous and vascular supply to the various viscera, and also a defective cerebral and spinal nervous development, and likewise capacity for function.

A careful and discriminating analysis of the types of disease and of morbid states which constitute the department of medicine called gynecology will show either that the constitutional element is the dominant factor in these conditions or else that it enters very largely into them.

It is true that when environment is sufficiently unfavorable evolves or typical human beings or those coming of sound stocks and having good constitutions will become diseased. The subject of immunity its essential nature and the principles and the processes which apply to and govern its manifestations are in detail as yet imperfectly understood. The view of the Fathers of Medicine that vital resistance is possessed in greater or lesser degree by different individuals remains true. It is also true that the same individual resists a certain form of infection at one time and becomes infected by the germ at another time.

Essentially the additions to the knowledge of the Fathers which have been made by modern investigators are the teachings of

Metchnikoff concerning the phagocytic function of the white blood cells or leucocytes and the teachings of Ehrlich and Wright concerning the formation of immune bodies in the blood plasma or antibodies which by chemical union with certain of the molecules of the invading germs devitalize them so that the white blood cells can destroy them by phagocytosis or they form antibodies in the plasma or lymph which will agglutinate or dissolve the invading germ or foreign body and thus rid the invaded organism of it.

When Virchow and his school brought forward the cellular theory of disease humoral pathology was called antiquated and unscientific. Modern serology and immunology have brought the profession back to the viewpoint of the Fathers as to the important functions of the blood plasma and lymph in the self limitation of disease or, otherwise as to the nature of the defensive or conservative reaction of the organism in ridding itself of poisons which reactions constitute pathology.

Humanity exists in three series or groups with a mixed series or subgroup and as each human being has his own health level or state of vital resistance it follows that the percentage degree of the incidence of infection depends largely upon the constitutional factor in an individual subjected to the influence of a pathogenic germ and the possibility of infection and in part upon the virulence or vitality of the pathogenic germ. This percentage degree as has been seen fluctuates in particular individuals from time to time. In general the vital resistance evolves is greater than that of hereditary devolutes and this is greater than that of environmental devolutes and even more than that of the mixed group devolved from both sets of causes. These are the constitutional factors entering into the nature of infection and immunity in gynecology and, likewise all prognoses as to recovery in particular individuals.

The constitutional factor entering into the problem of malpositions of organs and groups of organs, both pelvic and abdominal is twofold. All of the malpositions due to arrest of development and to the persistence of the



anatomical forms and relations of periods junior to that of the adult are clearly constitutional in their nature. In the past such malpositions have usually been classed as congenital although this is in large part erroneous.

Truly acquired malpositions of organs are due either to constitutional weakness—nervous exhaustion constitutional weakness due to disease malnutrition acquired atonicity of the ligamentous supports and of the cellular tissues about organs and to the absorption of fat from the cellular tissues or else they are due to injuries producing direct lack of support such as lacerations of the pelvic floor or to diseases or accidents bringing about continued congestion with increase of weight of the organ involved or they are due to increased pressure from adjacent organs or viscera or to maladjustments of lines of internal pressure due to alterations in the configuration of the trunk producing these maladjustments within the abdomen and pelvis.

Except some of the accidents causing traumatism and lacerations *all of these conditions have a constitutional origin* which involves the conclusion that *their scientific treatment must be constitutional in character* the removal of the cause regulated rest and exercise and the improvement of nutrition through the employment of regulated diet (even though local measures may also be advisable helpful or essential) in order to effect a cure and to maintain the subsequent health of the patient.

The essential nature of tumors their ultimate and their proximate or exciting causes there is every reason to believe is a combination of the presence of relatively embryonal cells or cell rests in the tissues of organs or in the tissues in general which under the usual conditions of health remain quiescent but which under excitation of either a physical or a chemical nature take on growth and being relatively embryonal or not somatized tend to produce tissues or structures imperfectly resembling the tissues which they would have formed had their somatization not been prevented during embryonal or foetal life. As the exciting physical or chemical

cause differs in kind from vital or growth force and as the cell or cells, are themselves atypical from arrest it is natural that the tissue formed by the multiplication of the arrested cell or cells should be aberrant or merely resemble and not be identical with the particular type of tissue or structure.

The writer has long been convinced that carcinoma and sarcoma are merely manifestations of marked degrees of arrest or degeneracy either general or particular or both. The whole weight of evidence clinical and pathological in the human and in animals together with the failure of the investigators in this department to find an adequate explanation or cause along the lines they have followed strongly supports this view. The existence of cancer areas or cancer belts commonly in shut in or isolated communities whose original settlers were largely of unsound stocks and the steady increase in the incidence of cancer *pari passu* with the increase in the percentage of both hereditary and more especially environmental degeneration in relation to the maleficent influence of urbanization (with its type of living especially for the poor so little in accord with the habits and conditions under which evolving man has lived in the past) is strongly corroborative of this view. It is further supported by such observations as are available concerning the incidence of cancer including sarcoma in wild animals when their environment has been so altered as to be inimicable to their welfare. The facts as to the percentage incidence of malignant tumors in domesticated animals and in wild animals kept in menageries and zoological garden in comparison with wild animals living in their natural habitat is equally corroborative. The reports of pathologists attached to zoological gardens and the facts of comparative morbid anatomy as they are set forth in such works are available to students of the subject. The high ratio of sarcoma among hares which are preserved in Europe, when permitted to increase beyond a certain number to the acre and the disappearance of sarcoma when the number is kept within due limits (and also the facts as to laboratory rat and mouse cancer) lend support to the

same view. On the contrary it is maintained that cancer is very rarely found in wild animals living in their natural habitat. The same contrasting set of facts is true of aborigines when living a barbaric or savage life and after becoming degenerate from encountering the evils of civilized conditions. For example cancer was practically unknown among the Negroes shortly after being brought from Africa, whereas today it is as common among them as it is among Caucasians.

Much more evidence of a similar kind is available all of which while not demonstrating from the standpoint of the laboratory the origin of cancer in degeneracy or arrest of development of an individual cell or cells when embryonal, and their subsequent stimulation, or irritation, into atypical growth in the adult, by either physical or chemical agencies makes such a hypothesis much more than probable.

In discussing this question with Professor Stockard, he stated that the facts of experimental teratology not only lend support to the above hypothesis concerning the origin of cancer but also equally explain the origin of benign tumors. The question as to whether arrested embryonal cells when irritated into growth and cell division form a malignant or a benign tumor depending upon the degree of their somatization when arrested (or the absence of any somatization) together with the nature of the protoplasmic poison which irritates or stimulates them into growth and multiplication of cells and also the intensity of the poison due to the quantitative dose of the particular poison whether chemical—as circulating toxins or physical—as the X ray, radium, heat—as in certain lip cancers from smoking or from traumatism—more especially when a long continued irritation is kept up. This view of the origin of tumors is a combination of the theory of Cohnheim and the clinical evidence human and from comparative medicine together with the facts of experimental teratology.

The application of the foregoing principles to obstetrics is that they constitute the genetic explanation of certain obstetrical problems (1) Sterility relative and absolute

(2) toxic states arising during pregnancy, (3) atonicity of the uterine muscle and lack of power on the part of the woman in labor to deliver herself partly from arrest of development of the uterus and partly from imperfect innervation, due to arrest of development of the nervous system with imperfect capacity for functioning, (4) lacerations in childbirth (5) abortions.

1 Absolute sterility in women is due to the absence of the ovaries fallopian tubes, uterus or a combination of these or it may be due to the absence of or the obstruction of the vagina, or to the imperforate condition of the hymen. Relative sterility is due to imperfections from arrest of development of one or more of the structures essential to impregnation or it may be due in a few cases to sexual incompatibility between the mates the nature of which is not understood although the fact is unquestionable and finally it may be due to obstructions or altered secretions, due to infection.

In this sophisticated day relative sterility is largely volitional and volition arises either from ignorance of the whole truth or more often from selfishness.

2 Toxic states are due either to ingestion of an undue amount of alimentary substances with consequent faulty digestion and defective anabolism or and more often to defective glandular organs of digestion as assimilation and excretion, together with defective ductless glands whose hormones activate and largely regulate the chemical processes of metabolism. It is natural that toxic states should arise more frequently in pregnant women than in the non pregnant because the pregnant woman must perform most of the processes of metabolism for two beings, instead of for one—herself. As a consequence those suffering from hereditary diatheses involving the organs of digestion and excretion—anabolism and catabolism—or those suffering from arrest of development from faulty environment or environmental hypoplasia are more subject to the incidence of toxic states than is true of evolutives or typical women. The morbid states more particularly referred to are clinically classified as vomiting in pregnancy and eclampsia.

3 Hereditary devolutes having a nervous diathesis have a well developed uterine musculature and as a consequence have sufficient driving power to deliver themselves in labor. However their nervous systems are atypical—hyperensitive and relatively explosive in functioning. As a consequence such women suffer inordinately in labor and tend to become exhausted from misdirected application of their energies and from the morbidity of the excess of their sufferings from the pangs of labor. They require the assistance of the obstetrician to effect delivery more frequently than is true of typical women.

4 Environmental hypoplastic devolutes are relatively sterile from the relative infantile or adolescent type of their sexual organs. The musculature of the uterus relatively is imperfectly developed and the innervation of the uterus is likewise imperfect. Also their general reserve store of potential nervous energy is small. As a consequence labor in this group of women tends to be powerless. The parturient tends to become exhausted and more frequently requires the assistance of an obstetrician to terminate labor than is true of any other class of women. Likewise as the anatomical parts involved in parturition are imperfectly developed they tend to function poorly, whether it be the generating of energy by the upper portion of the uterus or the passive relaxation to promote dilatation of the cervix uteri and of the vagina and of the muscles of the pelvic floor. Innervation and the correlation of nervous functions are imperfect.

5 Lacerations in childbirth are due either to imperfection in development of the structures involved or to disproportion between the passage and the passenger which disproportion may be essential or may be due to failure in the mechanism of labor itself. It is natural that a poorly developed cervix uteri should fail to relax and be stretched sufficiently to permit the egress of the fetus without laceration in the same percentage of cases that is true of typical women. This same state of facts applies to the dilatation of the small imperfectly formed vagina and pelvic floor of the environmental hypoplastic devolute as compared with typical women.

6 Abortions are due either to disease of the endometrium to toxic states of the mother or of the father or to criminal interference with pregnancy. The constitutional factor in each of these sets of causes of abortion is so apparent as not to require amplification.

The neuroses and psychoses of genital origin are both obstetrical and gynecological in their nature. The neurologist and the psychiatrist will each claim these functional nervous troubles as belonging to his particular specialty but such neuroses and psychoses as arise from the maladjustments of sexual life properly belong in the gynecological and obstetrical departments of medicine.

It is only by the study of woman as a functioning animal in the sexual sense and by discriminating observations and analysis of the functioning of her sympathetic and cerebrospinal nervous systems in relation to the sexual life from adolescence onward in its relations to the somatic, the mental and to the spiritual or emotional life and to the expression of each in function that an adequate understanding of the nature of woman and also of her nervous disorders, both somatic and psychic can be attained. This is one of the chief grounds for the existence of the specialty of gynecology and obstetrics and it is in the study of the psychic functions of woman and their influence and more especially of the influence of emotional states upon the health of women and in the causation of functional sexual disturbances that the general surgeon and the average family doctor fail in comprehension and insight as to whether particular symptoms have a local morphological basis or on the other hand are caused by morbid emotional states acting through the sympathetic nervous system and through the ductless glands. It is in just this large group of morbid condition that their lack of discrimination in diagnosis is most manifest and results in the numerous sins of commission and the lesser number of omission which they inflict upon their women patients.

#### CONCLUSIONS

1 The theory of environmental constitutional hypoplasia or arrested development from unfavorable environment operating at

any period from the preconceptional state of dual life in the ovary and testis to that of the youthful period in ontogeny which was presented to the profession as a medical hypothesis in 1908 and which the writer believed to be proved upon human clinical and pathological evidence is now shown to be equally supported by the clinical and the pathological facts of antenatal pathology and by the facts of comparative pathology and to be demonstrated by facts of experimental teratology.

2 The wisdom of the Fathers of Medicine as expressed in their discriminating analysis of the facts of the hereditary nature of the diatheses or dyscrasias together with the theory of environmental hypoplasia constitute the law of devolution in its relations to medicine.

3 In order to obtain a comprehensive understanding of the practice of medicine it is necessary to reject such of the teachings of Virchow and of his followers as are fallacious and to combine the clinical wisdom of the Fathers of Medicine from Hypocrates down with the known facts of experimental medicine and their correct interpretation and thus to arrive at the true point of view from which to study and to deal with the clinical problems which are the concern of practitioners of medicine and of each of its specialties.

4 The constitutional factor in gynecology and obstetrics as is equally true of the other departments of medicine is the chief element in the clinical problems which confront the practitioner in dealing with disease and with atypical organs and tissues and their functions because it is the factor which determines the nature of the reaction of the organism to a pathogenic environment or disease or it constitutes the sole factor in the atypical morphology and function in the patient.

5 The recognition, comprehension and employment of the foregoing principles will greatly enlarge the powers of the practitioner of medicine in diagnosis, prognosis and in therapy in which it will enable him to avoid many common if not habitual errors and positively to substitute general nutritional

and developmental measures for the local measures currently employed and thus to effect the cure instead of the amelioration of his patients' condition, when due to environmental arrest. Further it will enable him to give scientifically based advice as to methods of living when the biologic type of the patient is recognized to promote the development of environmentally arrested patients and to enable them to maintain their health by living within their particular potential or capacity to produce energy instead of attempting to live as is physiological for typical individuals but which will cause disease in the arrested—or hereditary and environmental devolves.

6 There remain unsolved two problems (1) The process of mechanism whereby atypical morphology and function of environmental origin in ascendants becomes at last hereditary in descendants. Apparently its solution will be found in the facts of the maleficent consequences of urbanization in human stocks which escape extermination by degeneration and disease and the variations or adjustments which ensue whereby acquired immunity is attained and similar facts concerning the consequences of the long continuance over generations of other unfavorable environment such as insufficient nourishment, malaria, the hookworm and food deprived of some element necessary to nutrition or so mistreated as to be relatively poisonous. It may become demonstrated by subjecting short lived animals to definite unfavorable environment for twenty or more generations and observing and correlating the facts thus obtained. Facts from biology as to species of animals and plants subjected for generations to inimicable environment will also aid in the solution. (2) The eradication of degeneracy and its prevention will probably find its solution in the development of eugenics and in the segregation or the sterilization of individuals manifesting the more marked degrees of degeneracy—more especially of the hereditary types.

# DEPARTMENT OF TECHNIQUE

## TREATMENT OF INFECTED GUNSHOT WOUNDS

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**I**N treating infected wounds the following resources are employed in the American Hospital in Vienna.

- 1 Removal of infected bits of clothing or other infected foreign matter
- 2 Wide incision and drainage
- 3 Immobilization
- 4 Continuous irrigation by the drop method with Dakin's solution of sodium hypochlorite or continuous immersion in hot antiseptic solution as acetate of aluminum

5 Stimulation of lymph drainage with Wright's solution of sodium citrate 1 part sodium chloride 4 parts and water 95 parts

6 Regular and prolonged daily exposure to the rays of the sun

7 Continuous exposure of all wound to the air without dressings whenever possible to avoid foreign body reaction

We have not made use of Euzen's solution of camphor and phenol

Small superficial slightly infected tangential wounds are rinsed with normal salt solution or hydrogen peroxide and covered with peru balsam or Mickulicz's salve

Of these agents those which have proved of greatest value are

- a Solar therapy
- b Open treatment without dressings to promote drying and to prevent foreign body reaction
- c Continuous irrigation with sodium hypochlorite solution composed of dry sodium carbonate chlorinated lime boric acid and tap water

Naturally the method of treatment and the agents to be employed in each case are determined by the nature of the infection and the character of the wound. For our own convenience we have made the following simple classification

Group 1 Deep wounds with small openings which provide poor drainage. These result usually from impacted rifle or shrapnel balls

Group 2 Large lacerated wounds involving deep muscles or bone caused usually by fragments of bombs shrapnel or grenade casings and dum-dums

Group 3 Large and small shallow or crater like superficial wounds due to tangential shots or impact of boulders and large superficial granulating wounds following incision for phlegmon

In Group 1 the wounds are excised or enlarged to afford proper drainage and at the same time to permit of the removal of bits of uniform grenade fragments or pieces of bone. If a limb is involved an immobilization splint is then applied. During the day the wound is exposed for hours to the rays of the sun and at other times is irrigated or covered with a wet dressing of Dakin's solution. In deep and extensive infections we have secured excellent results by immobilizing the part with a splint in such a manner as to leave the wound quite exposed. A rubber drainage tube is inserted to the bottom of the wound and the tube connected with a large receptacle containing warm Dakin's solution. The solution is allowed to flow into the wound by the continuous drop method as suggested by Carrel. A large hot wet dressing of gauze soaked in Dakin's solution and changed twice daily may be applied with advantage around the drainage tube.

As a rule in less than a week the discharge of the pus ceases even in the most active and serious infections and the wound surface is covered with healthy granulation tissue. Foul odors disappear with surprising promptness under the treatment with the sodium hypochlorite solution.

Serious and deep infections receive in addition to the continuous irrigation and the open wound treatment prolonged daily exposure to the rays of the sun. In superficial wounds solar therapy and open treatment are especially efficacious. Foreign bodies are prevented from coming in contact with the wound by means of square windows or frames cut out of cardboard and made at least one centimeter thick by rolling crepe

paper about the cardboard squares. This protective frame is placed around the wound and secured in position with adhesive plaster. Foreign body reaction is thus reduced to the minimum. Schumm, who suggested the cardboard window, has likewise prevented contact of dressings with the wound by the use of small wire baskets or cages likewise secured in position with adhesive plaster.

The open treatment of infected wounds as recommended last winter by Braun and since employed in German and Austrian Military Hospitals by Walzel, Loercher and others has in several hundreds of our cases proved of distinct and superior value. The actual healing factor in open treatment is still a subject of discussion. Walzel believes the benefit to be due chiefly to the drying out of the wound and condemns the old-fashioned clump dressing as a breeding nest of bacteria. Schlossmann looks upon the oxygen of the air and the drying of the tissues as important factors in preventing the growth of anaerobes. Many have spoken of the damage done to granulations by the frequent changes of gauze dressings. Braun especially deprecates the painful changing of dressings and Walzel as well as many other surgeons has been impressed with the advantages of frequent or practically continuous observation of the wound made possible by open treatment. Naturally also the great saving of dressing material is of considerable moment in all military hospitals. In our institution we have become convinced that not the least of the virtues of open wound treatment lies in the prevention of foreign body reaction. Every surgeon is familiar with the phenomena induced in the tissues by the presence of foreign bodies such as gauze drainage tubes and ligatures. Whether by a process akin to chemotaxis or by response to physical trauma or what not, it seems certain that not rarely wound secretion is continued by foreign bodies such as gauze or drainage tubes introduced to absorb it or carry it off.—*Ubi stimulus ibi fluxus*.

Large superficial granulating wounds entering the hospital from the transport are as a rule covered with bandages necessary of course for the trip in the transport train. They are usually bathed in a copious purulent or seropurulent foul smelling discharge. Such wounds when treated by the open air method often become dry in less than twenty-four hours. The granulations freshen, and epithelialization progresses rapidly. This is especially true of cases in which the open wound treatment is augmented by exposure to the rays of the sun. The patients

themselves prefer the open treatment with its absence of hard dry dressings rubbing against sensitive surfaces and without adhering gauze which tears loose granulations and young epithelium when bandages are removed. We have had no cases of secondary infection due to open treatment, and no difficulty in the matter of carrying away discharges. A rubber sheet drains the discharge into a receptacle at the bed side. It is interesting to note that after a few days of open wound treatment the rubber sheet is as a rule no longer necessary.

The solar rays considerably hasten the drying of secretions and add to the stimulation of epithelial growth. They moreover inhibit the growth of many pyogenic bacteria and the contaminating saprophites. During dark rainy days there may be little or no improvement in the condition of infected wounds, but when the sun shines and the patients are sent to the garden with the wound exposed to the sun a few hours each day improvement is prompt and unmistakable. We have regulated the time of exposure according to the comfort of the patient or according to the degree of chemical erythema or hyperemia of the adjacent skin. Wounds are at first exposed directly to the sunlight with no covering whatsoever. If smarting or burning begins or the adjacent skin becomes decidedly hyperemic, the wound is covered with a single or double layer of gauze laid upon a wire basket. We have had no complaints from patients undergoing sun treatment, and have observed no ill effects.

As the Reserve Hospital is much less a research institution than one for the most expeditious relief of suffering and restoration to service, we have not excluded other methods of antiseptic wound treatment in the attempt to establish the value of open and solar therapy in our cases. Although dependence has been largely placed on sunlight and open treatment, together with Dakin's solution for continuous irrigation, frequent use of hot baths in solutions of older and better known antiseptics has been made. Continuous hot baths in solutions of bichloride of mercury, permanganate of potassium, acetate of aluminum, and physiologic salt have been used with gratifying results in all varieties of infected gunshot wounds. Continuous immersion lends itself especially to injuries of hands and wrist or feet and ankles, as does continuous irrigation to the other parts. As a rule hot baths allay pain better than sedative medicines. The hot bath in Wright's solution is especially useful in those cases in which it is desirable to stimulate lymph drainage as in cases of diffuse hard cellulitis.

The resources for the treatment of infected wounds as mentioned above have been employed regularly in the treatment of amputation stumps. After amputations in serious infections of the extremities open treatment of the wound has been the rule. The guillotine or flapless amputation of Fitzmaurice Kelley originally recommended by Van Buren Knott has not been employed. We have had so much difficulty in pulling the skin down over the wound surface in amputations without flaps done elsewhere that it has seemed wiser to cut short flaps and leave them wide open to be closed with adhesive plaster straps after the danger of infection has passed.

#### ILLUSTRATIVE CASES

##### CASE. Service of D. Bettman

Wounded the thigh July. Operated upon the day later and metal splinters removed. Reoperated on three days later because of gas infection. Admitted to Reserve Hospital No. 8 July 3 with three large wounds of the thigh. These are superficial; the musculature. The cut to epifascial and fascial covering was destroyed. The largest wound was about ten inches long and about four inches wide at its greatest width. The other wounds were of about one half that size. Except for the common ly found soft syphilitic murmur the physical examination as negative. On removing the bandage the surfaces were found covered with thick heavy purulent and very offensive discharge. The wounds looked very unhealthy. Granulation tissue as present but pale and edematous. The wounds were washed with permanganate of potassium solution and sterile gauze dressings were applied. The following day the wounds were as stationary. For about four days treatment as above was carried out with little or no improvement. On the fifth day the patient was placed in the garden and the wounds exposed to the sun. When they were rebandaged the bandages were kept from coming in contact with the wounds by means of gauze rolls placed alongside. Within three days there was great improvement. The wounds had become almost dry. The discharge was sterile and had lost its foul odor. Epithelization had progressed noticeably. The granulations had almost entirely lost their edematous appearance. Now three weeks later the wounds are nearly healed except the largest one which is still about 5 inches long and about one inch wide. This case is an excellent example of sunlight therapy. Due to the location and size of the wounds it was almost impossible to protect them from contact with the bandages and after the second day they were bandaged in the usual manner. After several hours of sun exposure the wounds were so much drier that each morning there was but a slight watery discharge.

##### CASE. Service of Dr. Dunn

Patient 43 years old butcher by trade and very strong physically. He had been in the field seven months when wounded on July 7 by shrapnel which laid the left knee joint open. The patient was treated in the field hospital with dry dressings and came to the Reserve Hospital No. 8 on the tenth day of August with the left lower extremity in starch bandage. The odor as very foul so that other patients could not stay in the same ward. On August 1 the starch bandage was removed and the wound examined. The leg was almost completely disarticulated at the knee the patella hanging in mass of

granulation tissue. The articular surfaces of both femur and tibia were intact but the cartilage was eroded by the acute infection. There were immense flaps of connective tissue overhanging the knee joint. The wound as secreted large quantities of foul smelling pus which contained streptococcal chains and a few thick short bacilli. The lower leg was attached to the thigh posteriorly by thick flap of granulation tissue which contained the popliteal vessels. The soft parts of the lower third of the thigh were represented by lacerated mass of infected tissue so that it would have been impossible to amputate except by the guillotine method quite high up. A hooped plaster bandage as applied leaving the wound exposed. Continuous irrigation with Dakin solution by the drop method as employed and on August 1 the offensive odor had disappeared and there was very little discharge. During the next week there was large growth of granulations filled all of pockets of pus. These were mechanically broken open to allow entrance of the Dakin solution. From August 15 to 25 there as pus or foul odor. Amputation was done by the short flap method between the middle and lower third by Drs. Obermeyer and Dunn on August 26. On September 5 the wound had closed firmly by first intention.

##### CASE. Service of Dr. Kneth

Patient was wounded July 5, 1916 by rifle bullet entering the left arm lodging in the humerus and fracturing the same. He was treated in the field hospital by dry dressing over the aperture of entrance of the bullet and immobilization of the arm with a posterior splint. He came with a transport to the Reserve Hospital No. 8 August 11th the following findings. He complained of severe pain in the upper left arm and shoulder and was very weak. Upon removal of the bandage and splint it was found that the arm shoulder and anterior axillary fold were swollen, hard and inflamed and that the wound of entrance was closed. Temperature 102 pulse 96. Hot moist dressings were applied and patient was put to bed. The dressings are changed every three hours. The next morning the patient as taken to the operating room. The wound of entrance was re-opened another opening made lower down in the arm and it through and through rubber drains were inserted. About 500 cubic centimeters of pus was expelled from the wound. If too much dressings were applied and changed twice daily for week. The discharge did not decrease. The patient had normal temperature mornings but an afternoon and evening so of several degrees. Through and through irrigation with Dakin solution was then begun. The temperature became normal and the patient began to feel much better. Within a week the discharge of pus had ceased.

##### CASE. Service of D. Schumm

Patient was wounded early in the morning of June 19, 1916 on the Italian front by the explosion of mine. He suffered small laceration of the right thigh caused by impact of boulder. The next day the leg became painful and swollen and the patient became feverish. On June 29, 1916 there as diagnosed as gas phlegmon and several long longitudinal incisions were made in the thigh and the calf of the leg. The patient was transferred to Reserve Hospital No. 8 July 5, 1916. On admission the patient had three large superficial wounds one 7 centimeters long and 5 centimeters wide and the other 5 centimeters long and 3 centimeters wide on the outer surface of the middle and lower thirds of the right thigh. On the inner surface of the thigh was third wound 6 centimeters long and 3 centimeters wide. All were covered with strong granulation tissue and were discharging large quantities of thick greenish yellow pus. On the inner and outer surfaces of the calf of the right leg extending from just

below the knee downward were two similar wounds, one 9 centimeters long and 2 centimeters wide and the other 9 centimeters long and 3 centimeters wide. For the first four days the wounds were exposed to the rays of the sun during the morning and at night were covered with hot moist dressings of Dakin's solution. At the end of four days the discharge of pus had ceased and the carbolic window were placed about the wounds to prevent contact of dressings with the wounds. Treatment by heliotherapy was continued. On August 17 the wounds were entirely healed.

#### CASE 5. Service of Dr. Bettman

Three weeks before admission patient was injured by a rifle bullet passing through the hand. One week after the injury a small incision was made to evacuate pus. On admission to K. U. H. Hospital No. 8 the left hand was found to be greatly swollen and extremely tender. There was no motion of the wrist or fingers without great pain. On the dorsum of a large, ragged, open wound discharging,

with a foul smelling, pus. With a 7/16 inch bone fragment were discovered just under the skin. The skin of the palm was entirely missing and replaced by a granulating surface. X-ray showed a destruction of all the carpal bones except the triquetrum, pisiform and lunate. There was a fracture of the second metacarpal and splintering of the third and fourth metacarpal. The patient was first treated by hot moist dressings but as these did not relieve his pain the hand was given continuous immersion in hot permanganate solution for three hours each morning and alternated with hot moist dressings in the intervals. Pain persisted for about a week with occasional fever after which there was very little pain and no fever. A small red fluctuating mass formed a week later and this was lancee otherwise there was no operative procedure. On admission the man looked very sick, septic and icteric. Two weeks later he looked and felt well and could move wrist and fingers. The palm had entirely healed and the dorsum healed except for a small discharging sinus.

## A METHOD OF RE-ESTABLISHING THE PATENCY OF THE URETER IN PYONEPHROSIS

### PRELIMINARY REPORT<sup>1</sup>

By MARTIN MOLODY, M.D., SAN FRANCISCO

THE object of this paper is to bring before you in as concise a manner as possible a method of restoring the patency of the ureter in cases of hydronephrosis and pyonephrosis. A few preliminary remarks are presented as to the cause of pyonephrosis especially as the cause appertains to the class of cases for which this method is suitable.

Broadly speaking there are two forms of pyonephrosis. The one is secondary to hydrone-

phrosis and is very frequently associated with movable kidney or calculi. The obstruction is usually high up in the ureter, the infection being an ascending one from cystitis or it may be hematogenous. The other form of pyonephrosis develops in connection with pyonephritis is frequently due to disease in the lower urinary tract and is often associated with enlargement of the prostate stricture or bladder growths. These latter cases therefore occur more often in



Fig. 1. Shows a large catheter with a large stylette passed through the left kidney and ureter.

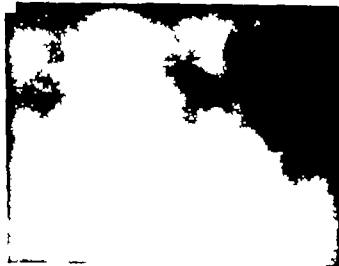


Fig. 2. Same catheter filled with collargol solution.



men are frequently bilateral the whole ureter being dilated. The former variety is more common in women and usually unilateral and dilatation of the ureter occurs only above the obstruction. The condition of the pronephrotic kidney has to be considered whether the amount of injury done to the renal tissue is small or whether the functional power of the secretory tissue of the kidney is totally destroyed. The condition of the second kidney is of prime importance and sometimes difficult to ascertain accurately. The exclusion of pyonephrosis and tuberculosis by nephrosis by clinical and bacteriological method is also necessary. Cystitis will often obscure your diagnosis. The treatment in those cases of pronephrosis has been mostly confined to the question of nephrectomy or nephrectomy and a great many hold that the radical operation is the only one.

In making a very brief search of the literature on pyonephrosis it is amazing how little is published on the subject. There is an interesting review on congenital structure of the ureter by Bottomly in the *Annals of Surgery* 1900. He believes a tripartite in it will sense a very narrow opening of the ureter. The great majority of the cases quoted by him refer to children but how do you explain the delay in development until adult life of obstruction in the ureter when the cause is evidently congenital.

Many dispute the point that a great number of these cases are congenital. The operative results on obstructive conditions of the ureter and pelvis are not very encouraging. Cabot states in a collection of cases operated on for renal and ureteral calculi that almost 50 per cent of the cases were not well after operation and that the majority of these unsuccessful ones were due to recurrent calculi. Many other statistics of a similar nature can be quoted. From the results obtained in various operative procedures for congenital and acquired malformation of the ureter and renal pelvis 30 to 40 per cent are failures. Some surgeons report a high rate, 50 per cent. Nephrectomy is often a secondary measure after the failure of other methods. The loss of a kidney is a severe penalty and its removal is frequently a great risk if the function of the other kidney is impaired.

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The treatment of associated conditions is necessary to aid in obtaining a finally good result. When you have a condition with movable kidney a nephropexy should be performed at the time of operation.

Another matter that requires attention is this. Where a chronic cystitis is present as regurgitation

tation takes place through the dilated ureter from the bladder to the kidney it is necessary to treat the bladder and urethral conditions frequently found in these cases as described in my article in the *California State Journal of Medicine* January 1915. Otherwise infection will be carried up from the bladder to the kidney and will cause delay in healing of the renal fistula. It would be interesting to know the exact pathological conditions existing one or more years after dilatation by this method. We know from experience that for a month after the ureter remains quite patent and that you can run more fluid through it to the bladder at a rate with which no kidney could compete so that if it does this for a month it should be fairly good for years after. This is a simple and efficient method of dilating strictures of straightening kinks due to a movable kidney or obstructions due to adhesive bands or aberrant arteries with the prospect of a more permanent result than is to be obtained from the numerous operative

procedures introduced for these conditions. Obstructions at the vesical orifice due either to stricture or prolapse of the ureter into the bladder (cystic protrusion of the ureter) can be treated by perforating or slitting open and dilating through the operating cystoscope instead of adopting the open surgical methods formerly recommended. I have opened a cyst with the Oudin current making a good wide slit in it and with dilatation it remained open for months afterward while the case was under observation. This method of course does not apply to impermeable ureters which are extremely rare even in many of the so called congenital cases. Tubercular conditions are naturally excluded. The following results are obtained from this method.

Patency of the ureter is re established.

Very irritable and sensitive bladders are kept washed out through the kidney.

A patent ureter with good drainage is a necessary preliminary to healing the renal fistula is assured.

## ENTEROPLASTY FOR THE RELIEF OF SIGMOID OBSTRUCTION

By W. FRANK FOWLER, M.D., ROCHESTER, NEW YORK.

THE writer lays no claim to originality for a method which has probably been utilized by others in like emergency. However, he is not aware that a description of the operation has ever been published.

Mr. W., age 60 years, was seen April 17, 1916, on consultation with Dr. I. B. Chapman in Brockport, N. Y. *Present illness.* An attack of pneumonia when a young man has been the only serious illness. There was nothing significant in his history except possibly a slight hematemesis which occurred 12 years ago. The bowels have always been regular.

*Present illness.* About April 3, 1916, he began to be troubled with constipation which would not yield to ordinary cathartics. This condition gradually grew worse until constipation became nearly absolute. At first very slight relief could be obtained from enemata. Flatus was expelled infrequently and in small amounts. There

was no abdominal pain or tenderness. The patient was in good health and spirits.



Fig. 1. Showing structure of sigmoid opposite sacral promontory.



Fig. 2. Showing enlargement of rupture by longitudinal incisions along free border of the sigmoid.



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W. W. (2) mentions seven operative method  
for the relief of sigmoid and rectal strictures and  
delineates an interesting original procedure  
Werelius (3) describes an ingenious operation  
which he employed for the relief of a benign  
stricture of the small intestine. The stricture  
was folded upon itself and a lateral anastomosis  
of the bowel above and below the constriction  
was made with clamps after the manner of per-  
forming gastroenterostomy. The writer con-  
sidered and abandoned this procedure because  
of the complicating rupture and a doubt that the  
meso sigmoid would readily lend itself to such  
manipulation in this particular case. The just  
claims of Werelius of lessened operative time,  
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#### CONCLUSIONS

1. Each case of intestinal obstruction is an individual surgical problem.
2. Two rows of permanent sutures may be required to insure union in an infected field.
3. The possibility of rupture at the structured point must not be overlooked.

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J. W. R. Surg. Gynec. & Obst. 9 5 54

INTRANASAL TREATMENT OF FRONTAL SINUSITIS<sup>1</sup>

By R. H. GOOD, M.D., Chicago

**T**EN years ago the rhinologist experienced considerable anxiety whenever he was called upon to treat a case suffering with frontal sinusitis but today on account of the advent of intranasal surgical method he is able to cope with this disease with no more anxiety than he has in treating antrum or ethmoidal sinusitis. Nine years ago when my first publication appeared in the *Journal of the American Medical Association* I received criticisms such as "the impossibility of getting into the frontal sinus with the rasp," "too much danger of meningitis," "establishing inadequate drainage," "operation only possible in small percentage of cases," "indicated in small percentage of cases," "impossibility of effecting a cure," etc. but all those criticisms came from those who had no experience in intranasal surgery of the frontal sinus. At this date it is unnecessary to waste time or ammunition to persuade the rhinologist to adopt the intranasal operation as its advantages are apparent to all and the operation is being quite universally adopted.

In this country it is a serious matter to disfigure a patient's face, especially in the region of the forehead where the movements of the orbicularis frontalis muscles become impaired and thereby paralyze the patient's facial expressions so necessary in orators, singers and stage performers.

The external operation usually severs the supra-orbital nerve which in addition causes numbness and paresthesia of the forehead and scalp. The danger of meningitis in the external operations which establish drainage through the nose is equal if not greater than in the intranasal operation where the rasp is employed. The external operation frequently requires months of dressings and bandages and prevents the patient from returning to his usual occupation during this period. Furthermore the external operation does not by any means always result in a cure. In my travels in Europe I saw more secondary than primary external frontal sinus operations. While I was a student a friend of mine was operated on twelve times externally by two eminent surgeons which did not result in a cure and the disfigurement was very marked. My knowledge of this case augmented my determination to operate on the frontal sinus intranasally.

I know of patients who were allowed to suffer

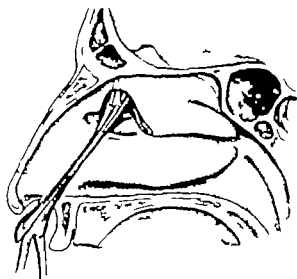
for months with frontal sinusitis resulting in serious complications just because the rhinologist hesitated to disfigure the patient or because the patient refused to be scarred. I am now of the opinion that every case of frontal sinusitis requiring operation should first have an intranasal operation as it gives one additional knowledge of the condition inside of the sinus. If an external operation becomes necessary the ethmoidal cells are then already removed and an ample drainage established from the sinus into the nose. I consider the removal of ethmoidal cells from the frontal sinus route poor surgery as compared with the nasal route. In cases with intracranial complication both the intranasal and external operation should be performed at the same time and the dura exposed.

I am of the opinion that performing an external operation today without first employing the intranasal method shows lack of knowledge and poor judgment on the part of the surgeon.

It is eight years ago that I published my last article in the *Laryngoscope* on the intranasal frontal sinus operation and having simplified the operation greatly as well as having more experience I thought best to write an article for publication in response to the invitation received from your society. I published an article on acute Frontal Sinusitis last year in the *Illinois Medical Journal* which takes up the etiology, symptoms and diagnosis. Time does not permit us taking up this phase of the subject.

The majority of frontal sinusitis cases get well with ordinary treatment such as the patient spraying the nose with 1 per cent solution of cocaine in adrenalin chloride 1:5000 morning and night. The nose should be sprayed about three times allowing a minute to elapse between each spraying. The patient should be instructed to blow the nose real hard by keeping the nostrils closed with the fingers and immediately thereafter make strong suction by negative respiration with the nose kept closed. This should be frequently repeated for an hour after the spraying.

Once a day the patient presents himself at the office where the rhinologist may apply into the middle meatus a 10 per cent solution of cocaine in adrenalin chloride 1:1000. Ten minutes after the application suction should be made by any of the suction devices with the patient in the



I Forceps bring out anterior end of the middle turbinate.



II Bone, for bringing out anterior end of ethmoidal sinus.

erect position. The suction is more efficient if one uses a syringe over the sinus while suction is made. A catheter is applied into the sinus several times daily when the patient is in the recumbent position to prevent crusting, the nose open in the morning to avoid toxic effects. A pin ten to fifteen grains of ephedrine three to four times a day is very valuable in acute cases. Calomel followed by a saline should be administered the second day. In severe cases I am in the habit of prescribing ten grains of urotropin every six hours but I am not convinced that it does very much good. If the sinus can be catheterized easily without trauma daily lavage is excellent treatment but if the tissues have to be traumatized each time it will do more harm than good.

If the above described treatment fails to relieve the patient one should open the anterior ethmoidal cell until a good sized cannula can be introduced into the sinus.

If the middle turbinate is large the anterior end should be removed. In my experience the removal of the anterior end of the middle turbinate alone does very little good unless one can easily pass a cannula after so doing. It is my rule now never to be satisfied with just removal of the anterior end of the middle turbinate but I open enough ethmoidal cells to enable me to lavage the sinus. This will cure the great majority of cases without further operation provided one has not waited too long before operating.

It stands on record that dry irrigation is the best result. The anesthetic irrigation of the drum produces no result. The catheter is simply because there is too much time elapsed to all serious pathologic changes.

Failing to relieve my patients with the above said methods I just could perform the intranasal frontal sinus operation with the rasp.

X-ray pictures are a great aid in determining the size of the sinus but the roentgenogram is a marvel as one can see into the sinus and outline its depth. Unfortunately but few have learned the art of making the roentgenogram so that it yet it cannot be universally employed. I consider roentgen illumination of great value and should never be omitted.

The statement is frequently made that many anatomical specimens show small sinuses so that an intranasal operation cannot be performed. We must however bear in mind the fact that it is the large sinuses which become diseased most frequently due to the fact that they secrete much more mucus than a small sinus and therefore have more difficulty in emptying themselves. My experience is that a very small frontal sinus rarely needs surgical interference and I have yet to get my first case of suppurative frontal sinusitis where I failed to get up into the sinus.

Cases of sinusitis with edema of the palpebral alveolus or orbital abscess or cellulitis should be operated on at once.

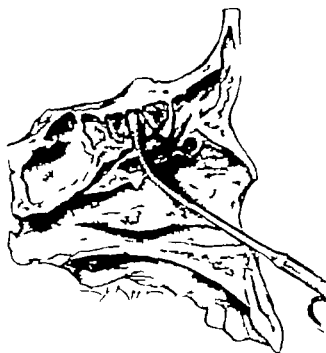


Fig. 3. Rasping out ethmoidal cell all the way up through bottom of frontal sinus. The mouth lateral surface of the rasp burrs the orbital wall.

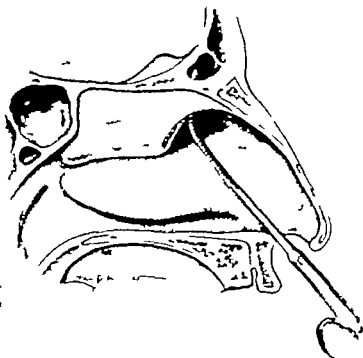


Fig. 4. Shows possibility of rasping without injury to cribriform plate of ethmoid or internal plate of the skull as the posterior surface of the rasp is smooth.

In cases of catarrhal sinusitis and acute suppurative sinusitis requiring operation it is my custom to rasp out the anterior ethmoidal cell all the way up into the floor of the frontal sinus and if this establishes a fair sized opening which it usually does I refrain from rasping much of the nasal pine.

In suppurative cases with orbital abscesses I make a larger opening by rasping away some of the frontal pine and then I make an opening through the lamina papyracea of the ethmoid and drain the orbital abscess through the nose. It is however not always easy to drain a large orbital abscess in this manner because the pus at times penetrates the peritoneum of the orbit so that it is often necessary to make an external incision into the abscess cavity to drain it.

I open the orbital abscess at its most prominent point usually above the inner canthus of the eye. In chronic suppurative frontal sinusitis the opening I made larger by rasping away the frontal crest or pine.

Future will begin to close of their own accord immediately after the operation has been performed providing good drainage has been established. It is self evident that osteomata frontal sinus cysts osteomyelitis and tumors of the sinus cannot be considered a frontal sinusitis and external procedures are necessary. While it is true that Schaffer in 1890 and Spie in 1899

did some work approaching intranasal frontal sinus surgery it was however far remote from being a real frontal sinus operation.

Dr. Ingall in reality the pioneer in this work and had it not been for him we would no doubt still be groping in darkness so far as the intranasal surgery on the frontal sinus is concerned. It revealed the possibility of getting into the sinus with a drill by way of the nose. Dr. Halle deserves the credit of operating on the frontal sinus intranasally under the direction of the eye with a burr. Somehow I could not convince myself that a burr was a safe instrument, and I was afraid to use it because of the difficulty of controlling a rapidly revolving burr on a long handle. It was this fear that lead me to think of another method.

In my boyhood days we used coarse horse hoof rasps made by hand and it was from this rasp I conceived the idea of making a rasp to rasp out the ethmoidal cells and the frontal crest.

I have greatly simplified the operation by discarding the chisels and the protectors so that I can describe in detail in this paper.

**Anesthesia.** It is now my practice to give the patient thirty minutes before operating a quarter grain of morphine hypodermically. With a cotton applicator saturated in adrenalin chloride 1:1000 and then dipped into flaky cocaine the

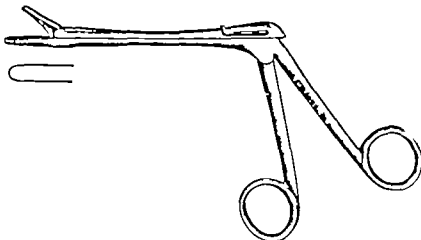


Fig. 1. The forceps.

entire ethmoidal region is thoroughly anaesthetized by rubbing the applicator repeatedly over the membrane. A 1 per cent solution of novocaine may be injected subcutaneously in the region adjacent to the inner canthus of the eye. In seven minutes I proceed to remove the anterior end of the middle turbinate (Fig. 5) and bite out the anterior ethmoidal cells with a biting forceps (Fig. 2) as follows. The forceps enters the ethmoidal labyrinth through the bulla, biting an opening through the labyrinth upward, outward and backward to the base of the skull always bearing in mind that the forceps must hug the orbital wall which is the guide. This opening is approximately in the region between the anterior and posterior ethmoidal cell. Care must be taken not to injure the inner boundary of the ethmoidal labyrinth which is the inner vertical plate and descends from the under surface of the cribriform plate and lies to its posterior side and terminates below in the free margin of the middle turbinate bone. By removing the ethmoidal cell with its remaining thin plate we know that we have not injured the cribriform plate because this structure lies internal to the inner vertical plate of the ethmoid. The rasp (Fig. 6) is now inserted at this point made by the forceps as indicated in Fig. 3) and all the cells

anterior to it are rasped out all the way up through the floor of the frontal sinus. The smooth lateral surface of the rasp hugs the orbital wall which serves as our guide. In this way the cells which creep over the orbit can be rasped away and this is of great importance in making a large opening into the frontal sinus. The tip of the rasp (Fig. 6) is smooth and slides along the floor of the skull. We now pass a cannula into the frontal sinus and squirt a 10 per cent solution of cocaine in adrenalin chloride solution into the sinus. In a few minutes we can proceed to rasp away some of the frontal crest. It is frequently possible to apply cocaine with an applicator to the crest after the ethmoidal cells are thoroughly removed. At this stage of the operation we are entirely anterior to the cribriform plate of the ethmoid and we can rasp well out far from injuring this structure or the internal plate of the skull (Fig. 4) is the posterior surface of the rasp. The smoother the upper cells are rasped away in this procedure and I do not know of a single case where these cells caused me any trouble whatever after the operation.

There is some danger of rasping through the orbital wall even though the distal surface of the rasp is smooth but we can determine this readily by placing the finger externally on the

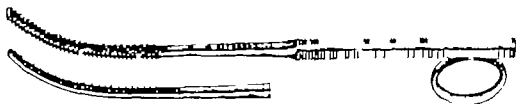


Fig. 6. The rasp.

region above the inner canthus of the eye while rasping. There is little harm done by so doing but there is nothing gained. There is no danger of injuring the lachrymal duct as this structure lies below the field of operation. By this method of operation we need not ask ourselves the question where the frontal duct lies or whether any ethmoidal cells lie external or anterior to the duct as these are all removed including the duct itself and the posterior wall of the ethmoid cells which were in the floor of the frontal sinus form the posterior boundary of the new osteum frontalis created by the operation.

Luc's ethmoid forceps (Fig 7) is very useful to remove the broken down cells caused by the rasp.

If there are soft granulation masses in the floor of the sinus I attempt to remove them with flexible ring curettes, but I have given up the attempt of reaching the remote areas in the sinus as one at best must work in the dark. In case the septum is deflected to the diseased side, it is necessary to do a submucous resection to enable us to approach the ethmoid cells.

It is my practice immediately after operating to apply tincture of iodine to the frontal sinus and ethmoidal region as an additional precaution against infection.

The patient should be cautioned not to blow the nose hard during or immediately after the operation as air may be forced through the lamina papyracea into the subcutaneous tissues around the eye. This causes enormous swelling or ballooning and frightens one who has not seen it before. It however subsides in several days.

A narrow strip of gauze is inserted into the sinus to facilitate the drainage of blood during the first twenty four hours, after which it is removed.

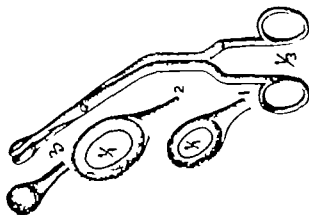


Fig 7 Luc's forceps Three types

It is very seldom that any external swelling takes place in the region of the operation. The patient is kept in the hospital over night. He is permitted to resume his usual occupation within three to seven days.

The sinus is lavaged daily by the surgeon, and as soon as possible the patient is taught to do this himself. If there is a tendency for the duct to close I insert dilators (Fig 8) before inserting the cannula for irrigation. A 20 per cent solution of silver nitrate applied to the nasal duct with an applicator will destroy the granulation tissue. If the discharge does not diminish, it is wise to apply to the sinus strong solutions of argyrol or weak solutions of silver or iodine. Occasionally it is necessary to remove granulation tissue when the silver is inadequate for which purpose I use a round tapering rasp (Fig 9). This is done in the office after cocaineizing.

The intranasal frontal sinus operation should be performed under strict aseptic precautions. There is much room for improvement along this line in rhinology. No matter where we go we



Fig 8 Dilator

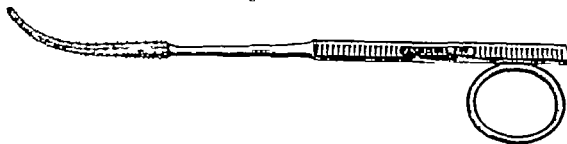


Fig 9 Tapering rasp



see no operations performed without aseptic precautions just because the idea is prevalent that since there are already so many germs in the nose there is no need of doing a clean operation. This is a great error and whenever we hear this statement we should resent it vigorously.

Years ago there may have been some excuse for carelessness in our technique but today with our added experience when we are operating in close proximity to the meninges it is high time that we learned the art of doing absolutely clean surgery.

## PROSTATECTOMY

### A CLINICAL STUDY OF FIFTY CASES WITH PARTICULAR REFERENCE TO POSTOPERATIVE TREATMENT

By W. B. DAKIN, M.D., Los Angeles

Intern, Los Angeles City Hospital, 1906. Southern California Medical College, Los Angeles, California. Hospital

**B**UT few surgeons can say of the majority of their operative cases a complete and uninterrupted recovery. Especially so is this of prostatic surgery. It has been my observation that many prostatectomy cases are left almost entirely with the nurse and interne or just the opposite — the surgeon and assistants do too much. By this I mean hypodermic medicine per month, Murphy drip per rectum or last but not least too extensive or frequent manipulation of the drainage system.

*Pre-operative treatment.* The success of post-operative treatment begins with the pre-operative stage. With the pre-operative treatment the patient can be exhausted with rules and treatment.

In this series of cases the pre-operative treatment averaged a little over two and a half weeks the longest period being two months. After whatever procedure was necessary to establish good bladder drainage and bodily elimination the patients were allowed to live as had been their former habit. They were not annoyed with rules of diet or restriction of the use of tobacco. They were encouraged to keep out of bed, take as much of a daily walk as their strength would permit and to keep out in the sun as much as possible. In every instance their strength improved and their daily exercise increased. Often as their day of operation approached they would ask, "Why should I be operated upon because I feel as well as I ever did?" Occasionally one of these patients would leave the Hospital under the impression that an operation was entirely unnecessary.

#### REVIEW OF CASES OPERATED ON

The average age was 68 years the youngest being 43 and the oldest 93. The number of

cases between 40 and 50 was 3, 50 and 60 5, 60 and 70 24, 70 and 80 13, 80 and 90 4, 90 and 95 1.

The most common presenting symptom was frequency and dysuria. There was complete retention in 11 cases and catheter life had been followed in 32 of the 50 cases. One patient had practiced self catheterization for seventeen years. There was complete retention during this time. This patient was 87 years old. He made a good recovery and left the hospital in three weeks.

The average amount of retention was 458 cubic centimeters. The largest amount being 1800 cubic centimeters, 7 cases having only 60 cubic centimeters. Those with the small amount of retention were as well relieved of their symptoms by the operation as were the more marked cases. Five cases had suprapubic puncture it being impossible to pass the urethral catheter.

The average duration of symptoms before operation was three and a half years the shortest period being three days with acute retention.

*Complications of other organs of the body.* In order of frequency arteriosclerosis, renal insufficiency, inguinal hernia, myocarditis, valvular trouble, asthma and bronchitis, vesical calculi (one of the 3 cases having 34 stones), epithelioma of the face, cirrhosis of the liver, double hydrocele, sacral decubitus and 2 cases of diabetes, 1 having 2.5 per cent sugar. Both diabetic cases recovered.

*Diagnosis.* Rectal examination was found to be a poor indicator of the real amount of prostatic tissue present. Several of these cases had a large amount of prostatic tissue in the bladder and very little to be felt per rectum. It is the author's opinion that cystoscopy should not be insisted upon if the general condition of the patient does not warrant it the diagnosis to be made in some other manner. No contra indications being

present, a patient with urinary symptoms suggestive of prostatic enlargement with little or no prostatic tissue to be felt per rectum should be cystoscoped even though spinal or some other form of anesthesia is necessary. Occasionally this procedure will avoid a few embarrassing and complicated moments at the operating table.

About 25 per cent of these cases were brought to the hospital in the ambulance with an enormous retention and several of the cases in a semi-comatose condition. Not very promising material from which to expect a low mortality rate whether operated on or not.

*Functional kidney tests.* Phthalein was the functional test of choice, however an earnest endeavor was made to check up with urea estimation and general urinalysis. In every case of delayed appearance or a markedly decreased output of the dye the urine showed corresponding evidence of renal impairment. Four cases of marked kidney impairment were operated on because long continued pre-operative treatment did not improve them, and their general condition was gradually getting worse.

With careful postoperative attention three recovered but the fourth died within 72 hours.

*Anesthesia.* Spinal or nitrous oxide and oxygen has been given the last year. Novocaine was used for the spinal until we were unable to procure more. Lately tropocaine has been used.

*Operative technique.* The usual operative procedure for suprapubic prostatectomy was followed. The abdominal and bladder incisions were perhaps a trifle higher than usual, and considerable care taken to suture muscle and fascia in closing the abdominal wall. The incisions were only large enough to permit a small bladder exposure. Usually only one or rarely two skin sutures were needed.

*Postoperative treatment.* Patients that have been built up in a general way and operated on carefully with a good anesthetic as a rule give no trouble. If a bladder drainage tube has been placed too far down into the bladder and presses against the bladder base or muscle, and skin sutures have been carelessly placed we must expect pain and discomfort.

Whatever bleeding there may be occasionally forms into small clots in the tube. If the drainage continues into the siphon bottle regardless of the appearance of clots in the glass connecting

tube the patient is better off left alone. This is especially so when the surgeon needs to depend on an inexperienced nurse. The operator should if possible give the patient his personal attention the first 24 or 48 hours if any manipulation of bladder drainage is to be instituted.

After the operation the patient is placed in a warm bed the head of which has been elevated 6 to 8 inches. As soon as possible the drainage tube is connected there by lessening the possibility of clots forming. As soon as the patient is comfortably settled in bed he is encouraged to drink a glass of egg nog to which has been added eight cubic centimeters of brandy.

The first day or two the patient is left strictly alone except for minor adjustments of bedding to make him more comfortable. Only occasionally is it necessary to change the abdominal dressings. On the second day the tube is removed from the bladder and as small a urethral catheter placed in the urethra as will carry the drainage. Cases with considerable mucopurulent debris in the bladder will require a larger urethral catheter.

Only 5 cases of this series were unable to comfortably carry the urethral catheter. These patients were allowed to drain through the suprapubic opening. By means of intermittent urethral catheter drainage these cases were able to carry a catheter in a few days.

By keeping suprapubic wounds as dry as possible and clean of slough whenever the drainage tube has caused slough to occur, and by firmly supporting the wound with a small strip of zinc oxide adhesive and a good abdominal binder the patient will be made more comfortable. With these cases primary union will invariably occur along the line of suture and with the occasional stimulation of the remainder of the wound with silver nitrate complete union may be expected from one to three weeks earlier than usual.

After the second day infected bladders are irrigated through the urethra and suprapubic wound. Clean bladders are irrigated only every second or third day. About the seventh day when the bladder wound is apparently nearly closed the irrigations are carried on by return flow through the urethral catheter. With these cases the average time of closure of the bladder wound was nine days and complete closure of the abdominal wound in seventeen days.

## THE CENTRAL-EYED NEEDLE IN SURGERY

By IERCIVAL P. COLE, M.B. F.R.C.S. LONDON, E. GLAXO

THE useless complication and modification of instruments is undoubtedly to be deprecated. The only justification for altering the construction of such a fundamental tool as the surgical needle is that a good purpose shall be served thereby. The tendency of modern surgical technique is to become more rigid in an endeavor to reduce infection from all possible sources to a minimum. This tendency is reflected in the altered type of the commonest surgical instruments. The slow but steady supersession of the short five inch artery forceps by longer and more powerful patterns is a prominent instance. The surgeon has been accustomed to gauge the efficacy of his technique by the presence or absence of frank suppuration. The absence of frank suppuration is no proof that sepsis has been eliminated. Fortunately, or unfortunately, the margin for error in most operations is considerable and it must be commonly known and noted that apparently the same immediate results accrue to the particular and careless alike. But even in operations where such a margin for error obtains it is probable that the operator who cherishes an ideal in aseptic technique will secure the best results. The remote postoperative results for example in a series of laparotomies one is inclined to think would testify in no uncertain way as to the original methods adopted. In testicular adhesions, ventral hernie and stitch sinuses are concrete punishments for technical sins.

But the fallacy of the generally accepted gauge is demonstrated more forcibly in operations where the margin for error is much smaller. I refer to what may for the sake of brevity be called foreign body surgery including operations such as plating, grafting and filigree imbedding. Many observers during the progress of the present war have noted the recrudescence of sepsis when with a soundly healed wound an operation has been undertaken to remove a metallic foreign body which had been retained. This is no new observation for similar phenomena differing in degree rather than in kind are met with in civil practice associated too with the introduction of metallic bodies such as plates and filigree. How frequently obvious suppuration occurs in fractures treated by the open method it is difficult to determine but it is certain that suppuration ensues more often than many operators would care to admit. The removal of plates is by no means rarely rendered necessary in cases with no evidence of obvious sepsis. I have on several occasions had to deal with plated fractures where after a considerable period had elapsed no union had occurred although the wound in the soft parts had soundly healed. What is found in such cases? The plate is loose as are the screws and these are surrounded by a discolored necrotic grumous material which is also found between the bone ends. The plate is removed the cavity curetted and union as a rule promptly occurs.

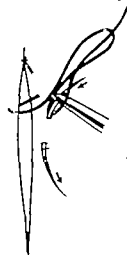


Fig. 3 Modified Cushing lock stitch

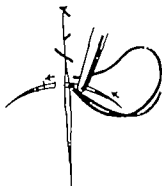


Fig. 4 The same as Fig. 3

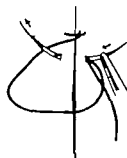


Fig. 5 Lock stitch



Fig. 6 Lock stitch

Can there be any reasonable doubt that this condition is due to sepsis and that the surgeon is at fault?

Some cases of filigree implantation bear witness to the same effect. The wound heals soundly and all seems well. After a varying interval a sinus forms due to suppuration arising in connection with the foreign body introduced. The surgeon may blame himself but he is more likely to ascribe it to some idiosyncrasy of the patient or to what he is pleased to call auto-infection. Many surgeons regard the guarding of skin edges and measures adopted to eliminate as much as possible the handling of the wound ligatures and sutures as the sheerest surgical pedantry. The available evidence tends to show that the more rigid the technique of the operator the fewer will be the failures of the types herein discussed.

The aim of the central-eyed needle is to help toward the attainment of this technical ideal by assisting to reduce handling of needles, wound, and ligatures to a minimum. For its use a needle holder is necessary. The jaw should preferably be lined with brass or lead but any ordinary pair of pressure forceps serves the purpose. The fundamental principle involved is to enable the return stitch to be made with the same grip that pulls the needle through, thus obviating the readjustment that must necessarily be made at each stitch if the ordinary terminal eyed needle be used. To those accustomed to the ordinary needle this tendency to readjustment is difficult to conquer as the action through long use has become automatic. With a little practice however a ready manipulation of the central eyed needle can be easily attained. Its use is not

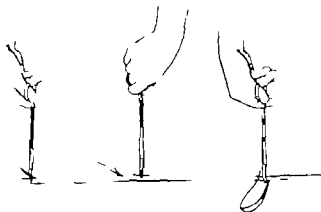


Fig. 5 Ordinary Cushing

recommended for intestinal suturing as in this case any form of needle holder is cumbersome and unsatisfactory.

The diagrams illustrate a few methods of stitching and mode of use. With the curved needle it will rarely be possible to utilize the ordinary overstretch but the entire elimination of this stitch from surgical technique would be no great loss. The needle is necessarily rather weak at its center but only moderate care has to be exercised to avoid breakage provided the needle is sharp. Owing to this weakness very fine needles are found to be impracticable. To prevent the needle from constantly becoming unthreaded the suture should be passed through the eye twice or a double suture should be used the two ends being knotted together. If the tissues to be sutured are tough or the suture material thick, the latter plan is undoubtedly the better. Owing to the conditions at present existing there is considerable difficulty in obtaining these needles in any but a few selected sizes.

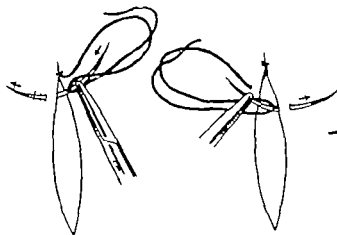


Fig. 6

Postmortem stitch

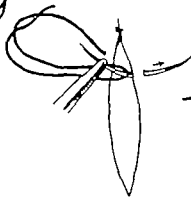


Fig. 7

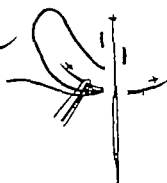


Fig. 8

Continuous Halsted



Fig. 9

Curved and straight needles

# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

B. GEORGE GELLHORN M.D. F.A.C.S. S. LOUIS, MISSOURI

It seems but yesterday that we listened to or participated in heated discussions as to the probability of the ovary possessing metabolic function in addition to that of producing eggs—and today the teaching of internal secretions is so firmly and definitely established that it has given us an entirely new outlook upon medicine. Bell's work on the experimental side and Falta's book on the clinical aspect of internal secretion approach the subject from general viewpoint. The new book by Bell covers a special phase of the problem.

In this monograph of some 200 pages the author has set for himself the task of demonstrating the fact that the reproductive functions in the female are directed and controlled by all the organs of internal secretion acting in conjunction. If terms sex complex, the sex characteristics and the functions appertaining to them and thus sex complex he contends is produced and maintained by a definite genital system formed by the association of all endocrine glands. Every fertilized ovum is potentially bisexual on hardly needs any further proof than the embryological remains of the latent sex which always exist in the genital ducts. Whether the ovum will develop into maleness or femaleness is according to the prevailing belief dependent on the sex glands. This exclusive influence of the gonads upon the determination of the sex is emphatically denied by the author. The ovaries alone are not responsible either for the primary or secondary female characteristics. Many if not all the organs of internal secretion influence the genital characteristics and all the endocrine organs as well as the gonads have normally a primary tendency to produce either masculine characteristics and functions or feminine. This last theory presupposes another assumption namely that in the sexes the endocrine organs—other than the generative portions of the gonads—possess functional as well as structural differences. Thus then is the thesis that femininity itself is dependent on all the internal secretions. The *modus operandi* as we read the book seems surprisingly simple. The femininity producing secretions call forth responses in the metabolism the most important and obvious ones of these are associated with the metabolism of the lime salts and thus

thought recurs throughout the book like red thread. If the perfect harmony of the endocrine glands is disturbed the metabolism of the lime salts is affected and in consequence the sex complex becomes deranged. This applies not only to physical conditions but also to mental and psychical phenomena both in health and disease.

The temptation is great to quote many pages from the book but the editor would probably enter his veto and it is obviously impossible within the scope of a short review to show just how the author proceeds to support his contentions from literature and on the strength of extensive personal investigations. Let it suffice to say that we have to deal with a work of absorbing interest and prime importance. By associating disjointed facts it renders many phenomena clear which heretofore have been obscure. It leads us into intricate problems which make the gynecology of today appear crude and empirical. It points the direction in which the future of our specialty is likely to develop and acts as a fruitful stimulant to further researches into this newly opened field of medicine. Moreover it is written in so attractive a style that the study of the book affords a keen literary pleasure. The numerous histologic pictures are most instructive and the colored photomicrographs are of unusual excellence.

Even the warmest appreciation of the book does not necessarily imply that we are ready to subscribe to all the views set forth by the author. We may grant the plausibility of many of his arguments and may even welcome a new and comprehensive theory in a field which has been obscured by ephemeral speculations. But there are yet too many gaps in our actual knowledge the literature vast as it is still too contradictory and our methods of investigation are far from perfect and so it seems advisable to suspend our complete acceptance of the author's theory. However as a working basis it may well serve the purpose of our science until further experience may have vindicated its correctness. It would have been a herculean perhaps an impossible task to consider the entire literature on the subject. Yet we should have liked to see a reference to the important contributions by such men as Loeb, Falta, Porges and Hofstaetter. Bell's book has had a precursor in an extensive monograph by Novak of Vienna who in 1913 suggested that the development of sex characteristics depended not only on the ovaries but to an even greater extent on other

THE SEX COMPLEX. A study of the Role of each of the Internal Secretions. (The Female, Male, and Fetus) by B. George Gellhorn, M.D., F.A.C.S. New York: W.B. Saunders Co. 1924.

endocrine glands. This work, which apparently has escaped the attention of our author, serves to strengthen in many respects the stand taken by the book before us. The book before us must needs appeal strongly to an unusually large and diversified circle of readers and while its usefulness to gynecologists, physiologists and pathologists is evident it is not so much to say that its study would greatly benefit the medical profession at large.

THAT writers of modern gynecologic textbooks can no longer ignore the problems of internal secretion nor consider them largely of theoretical importance is well shown by Graves who has just published a work of exceptional value.<sup>1</sup> The first part of this tome deals with the physiology of the pelvic organs and with the relationship of gynecology to the general organism. The author who proves himself abreast of the latest advances in medical thought introduces here a consideration of the rôle of the several endocrine glands in gynecology and while the available space for this subject is of necessity limited in a general work on gynecology a happy faculty of lucid albeit brief expression together with a remarkable expository skill have enabled the author to give to the reader a clear picture of the present status of the question and the frequent reference to the practical application of the knowledge thus far obtained cannot fail to arouse in the student the desire for further study. Of equal importance are the ensuing chapters on the relationship of gynecology to all the other organs of the body a relationship which should be self evident but seems too often neglected in the teaching and practice of our specialty.

The second part of the book includes a description of those diseases which are essentially gynecologic and the third part is devoted exclusively to the technique of gynecologic surgery.

Thus a variety of purposes is taken into consideration in this work. Parts I and III serve the needs of the advanced student and the general practitioner who includes gynecologic patients in his clientele. Part II furnishes the undergraduate student who is taking his initial course in gynecology with the necessary ground work. There is this unusual feature in the book, all the 303 half tone and pen drawings have been made by the author himself. Their high degree of perfection implies power of accurate observation and this same power manifests itself throughout the book in the way in which important points are brought forward and unessential ones relegated. The description of operative procedures both in the text and by way of illustrations is convincingly clear so that the student may be safely guided. There are also 122 microscopic drawings scattered through the second part. They show the author's firm foundation upon pathology and they are so exceedingly well done that with the help of the descriptive legends appear

ed to them they represent a veritable course in gynecologic histology.

The dignified appearance of the entire work corresponds to the prominent position it will hold among the best textbooks on gynecology.

FROM the Medical School of Glasgow two books relating to our science have emanated within a short time of one another. Munro Kerr<sup>1</sup> publishes the third edition of his *Operative Midwifery*. In this book of more than 700 pages the well known author offers much more than the title would indicate. He gives us a fairly comprehensive treatise on the pathology of pregnancy and labor and discusses the causes, symptoms and diagnosis of the various conditions that may produce dystocia. Greatest emphasis is naturally laid on therapy and the very extensive experience of the author and the candor with which he acknowledges the lessons taught him by his failures make the book extremely valuable. The old adage that we learn more from our mistakes than from our successes applies pre-eminently to obstetrics. This personal note strikes me as very attractive. The perpendicular pronoun is objectionable only when it is employed solely to herald personal achievements but when it is used as in this book chiefly to denote the response to stimuli received from other workers in the field it is most useful and fully justifies a new text book on obstetrics where there is already such an embarrassment of riches. There are 37 chapters and each represents a separate article in which the author tries to indicate what is becoming more apparent every day that the art of midwifery can no longer be considered a subdivision of medicine but must be regarded as a branch of surgery requiring a thorough knowledge of surgical principles.

Only a cursory selection of questions raised can be indulged in at this time. In classifying the causes of dystocia the author ascribes less importance to faults in the expulsive forces than is commonly assumed. Difficulty and delay in labor are more frequently due to some departure from the normal in the pelvic cavity or to the position or attitude of the child. A rectal examination is rarely if ever called for in obstetric practice. Chloroform is almost exclusively employed in England as the anæsthetic in parturition. The results of injections of scopolamine and morphine in the Glasgow Maternity Hospital have been fairly satisfactory and are being continued at the present time. Kerr is an enthusiastic advocate of the axis traction forceps but warns against undue amount of traction. Extreme force means that the instrument is either used unsuccessfully or that it is unsuitable and that some other operation should be substituted. If the retraction ring of Bandl is distinct forceps should be employed only very occasionally and with great care and in contracted pelvis if the head is still movable forceps is absolutely unjustifiable. It is

interesting to note that England seems to be the only country where forceps is applied in the left lateral position as a matter of routine. In considering the question of caesarean section in deformed pelvis in suspect or infected cases the author is convinced that craniotomy should sometimes be chosen even though the child be alive. So long as hysterectomy is the only alternative to craniotomy in such cases it is questionable if we choose wisely if we select the former operation.

To sum up this book appears to us a real guide to the difficulties and complications of obstetric practice and may safely count on a warm reception from the profession in this country.

THE same prediction cannot be made unreservedly for the second book from the Glasgow School. This *Manual of Gynecology* differs in no essential from other short textbooks on gynecology and in so far as it acquaints students and practitioners with the present status of our knowledge it is fully acceptable. Only where it introduces the personal technique of the author it is likely to meet with some opposition at least in this country. The recommendation for instance to dilate the urethra for digital exploration of the cavity of the bladder would seem to us rather antiquated and we would wish that the author when speaking of inspection of the bladder would not limit himself to Kelly's endoscope but would consider some of the excellent cystoscopes which modern urology has placed at our disposal. Bimanual examination of the pelvic cavity according to the author should seldom be omitted—we would substitute never for seldom. In discussing penneorrhaphy he advises the beginner to place a finger in the rectum occasionally as a guide to the position of the rectal wall and in the repair of complete lacerations he unites the torn rectum with catgut sutures which are tied within the rectal passage. Both these procedures seem to us to threaten an aseptic course of healing. Even the frequent use of a 5 per cent solution of carbolic acid which is recommended for the surgeon's hands will not remedy matters not to mention the serious consequences it may have upon the surgeon's kidneys.

In advanced cases of cancer of the cervix the author suggests curettage of the growth and treatment with a strong antiseptic such as carbolic acid for several days before the abdominal operation is performed. We believe that in this country operators have very generally profited by the experiences of Wertheim, Bumm and other pioneers in this field to the effect that curettage and cauterization should be done immediately prior to operation lest cancer particles be precipitated into the general circulation.

The recommendation of the bilateral removal of normal ovaries in certain instances for *Mittelschmerz* is almost certain to create a decided protest. The author fails to realize that this intermediate dys-

menorrhea which by the way is rarely severe is but the expression of ovulation as we have recently learned from Frenkel and others. In acute gonorrheal infection of the uterine endometrium the cervical canal should be dilated. The interior of the uterus should then be swabbed with dry gauze before the application of pure carbolic acid. Granting that our own ultraconservative treatment does not yield brilliant results one may well wonder whether ascending gonorrhea or uterine uterina would more frequently follow such active therapy.

IN order to hold its own in the galaxy of excellent textbooks of which America may justly be proud a new work on obstetrics must needs have a good many attractive features. It is then a pleasant surprise to find among the books received for review one that possesses an individuality all its own and exhibits a number of qualities which will make its general acceptance a matter of certainty. The author has succeeded in pouring new wine into old bottles. He has omitted the traditional sections on embryology which has become a science in itself and can be adequately treated only in a separate work. The section on anatomy is omitted because such preliminary knowledge must be taken for granted in every student of obstetrics. Fetal monstrosities interesting as they are are discussed but briefly and only in those forms which are likely to occur in daily practice. The description of rare developmental anomalies is left to special works on teratology. Of the theory of pure obstetrics only the essentials are given about as much as the student ought to know or is likely to remember enough also to serve if desired as a ground work for further study.

Having thus gained a good deal of space the author contracts his attention upon what the practitioner actually needs in obstetrics the physiology and pathology of pregnancy labor and puerperium the methods of examination the diagnosis and management of normal and abnormal conditions. A fluent writer he knows how to paint vivid word pictures that in clearness and completeness leave nothing to be desired and as an experienced teacher he does not hesitate to repeat not once but several times the points he wishes to impress upon the reader's mind. The same object is achieved by short summaries at the end of several of the therapeutic and diagnostic chapters. Where so much is good it is perhaps unnecessary to point out a single chapter and yet the section dealing with the indications for and the technique of the induction of abortion and of premature labor appears particularly promising.

Like every other textbook this too is to a certain extent a compilation but the individual attitude is strong throughout and where traditional views and advice do not come down with his own concepts the author tersely registers his dissent.

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXIV

FEBRUARY 1917

NUMBER 2

## FASCIA AND FAT TRANSPLANTATIONS<sup>1</sup>

By DEAN LEWIS M.D. F.A.C.S. Chicago

SINCE Kirschner in 1909 published the results of his experimental work upon the direct transplantation of fascia this material has been used extensively in many different fields of surgery. The stimulus given to plastic surgery by the demonstration of the feasibility of the direct transplantation of fascia aroused interest in the direct transplantation of fat for in certain types of plastic surgery both materials have to be transplanted together or the fat must be transplanted first to prepare for the direct transplantation of fascia.

Fascia is an ideal material for transplantation. The amount is relatively inexhaustible. Enough fascia can be removed for any plastic work that has to be undertaken without interfering with the function of the part. Fascia is so thin that it is easily permeated by serum, little or no degenerative changes occurring after direct transplantation. Fascia also has great strength for it has been demonstrated that a loop of fascia fastened in a vise will sustain a weight of 90 pounds without breaking the ends of the fascia slipping from the vise first. A loop of perosteum fixed in the same way breaks under a weight of 13 pounds.

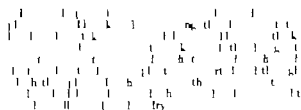
All the experimental work which has been done demonstrates conclusively that fascia transplanted under suitable conditions into subcutaneous fat or into muscles remains viable. It is not encapsulated like a foreign body, neither is it infiltrated by leucocytes,

nor do the nuclei and fibrillæ lose the staining reactions ordinarily shown by living tissues.

It is important to determine whether or not fascia undergoes cicatricial contraction when transplanted for if such should occur to any great extent the field of fascial transplantation would be distinctly limited. Fascia contracts somewhat on being removed from its bed and a piece of fascia lata is usually smaller than the bed from which it is removed. This is sometimes called the primary contraction. Lewis and Davis observed that fascia transplanted subcutaneously unless fixed by suture tended to roll up in a ball but when examined histologically this tissue did not present any evidences of cicatricial changes. In order to determine whether or not fascia undergoes so called secondary or cicatricial contraction Kolb placed pieces of fascia about the bowel of experimental animals and found that contraction of the fascial bands occurred which caused intestinal obstruction. In these experiments another factor the peritoneum is introduced and I believe that the changes in the fascia are secondary to peritoneal trauma followed by scar formation. This so called secondary or cicatricial contraction has been emphasized by Kredel and has been regarded by him as an argument against the use of fascia as material for tubularization after neurolysis. This will be discussed later under the subject of nerve repair and neurolysis.

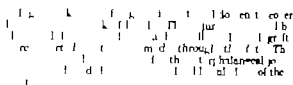
<sup>1</sup>Read before the Clinical Congress of Surgeons of North America Philadelphia, October 9, 6





#### REPAIR AND RECONSTRUCTION OF TENDONS

Reconstruction of tendon by bridges of catgut silk or silver has never been entirely satisfactory in repair of the nerve and the skin often fill well the insertion of the foreign material and proliferation neighboring tissue have in some cases invaded the bridge and limited the function of the newly formed tendon. This criticism applies particularly to the reconstruction of tendons lost as the result of infection or trauma. The advantage of the direct transplantation of tendons in the repair of tendon defects has been especially emphasized by Kohn. There are some disadvantages in the use of tendon as a direct transplant. The amount of tendon that can be used for direct transplantation without seriously interfering with function is small. The tendon of the palmaris longus is practically the only one that can be used and the amount furnished by these two tendons would not be enough for the reconstruction of a number of tendons as for example when the common extensors of the fingers have been destroyed. The objection has also been made that tendon when transplanted undergoes degeneration in the deeper parts as indicated by a collection of leucocytes and the



poor tuning reaction of nuclei and fibrilla. Kohn and his associates have emphasized these changes and believes that the changes are more or less permanent for he does not think that the peritendineum externum and internum repair the degenerated tissue for the peritendineum has according to him no specific function in repair such as the perosteum has. He attempted to divide tendon which he would transplant into small pieces in order to secure better nutrition but this was impractical.

Transplanted tendon behaves differently depending upon whether or not functional activity is assumed early. The principle announced by Roux that the fate of transplant providing that ordinary biologic laws have been observed is dependent largely upon whether the function for which the tissue was originally intended has been resumed early is often overlooked when discussing the fate of transplanted tissue. This principle is so beautifully illustrated in the case of tendon transplant that I would like to review the changes occurring in tendon transplanted subcutaneously and into a defect in a tendon which is made to assume function early for these changes indicate procedures which should be followed in both tendon and fascial transplantation if success is to be attained. Pieces of tendon transplanted subcutaneously tend to shrink. When removed some five weeks after transplantation they are found to be but one third as large as when placed in a tendon defect and made to functionate. Although such pieces can be easily identified as and have all the physical properties of



Fig. 3 Tenolysis for a the ions foll in, an electric turn flexor tendons at the wrist re adherent to a dense scar so that finger were fixed in an extended position. Flexor tendons were dissected free and separated by thin fat grafts. The scar was dissected out and a graft with considerable fat was transplanted from the abdomen. Later some of the fat was removed from this graft. While flexion is still limited the patient has been able to resume his work as a lineman and is quite satisfied with the result.

tendon except for a considerable loss of luster they show no proliferative changes in the peritendineum as do transplants which have been made to assume function early. Microscopic examination of tendon transplanted into subcutaneous fat shows that the fibrillae and nuclei stain well and that the segment may be regarded as viable. There is however some leucocytic infiltration and no evidence of proliferative change. Such a transplant may be compared to a paralyzed limb. It is alive and has circulation but it has become shrunken.

The changes occurring in a transplanted tendon made to functionate early relate mostly to size and form. At the end of seven days a transplanted segment which has not increased much in size lies in a mantle of grayish red granulation tissue which is usually separated from the transplant proper by a delicate layer of connective tissue. At the end of seventeen days a transplanted segment is definitely enlarged and the surrounding layer of granulation tissue has formed rather intimate union with it. At the end of three weeks the transplanted segment is two to three times as thick as the tendon on the opposite side. The transplanted segment becomes fusiform and no longer tapers to the point of attachment as does the normal tendon. The transplant is usually widest at the middle there being a gradual reduction in size to the line of suture at either extremity.

All these changes are most marked in the



Fig. 4 Cross section of a piece of fascia from the rectus abdomini transplanted into the subcutaneous fat of the abdomen and removed 23 days later. This fascia is alive; there is no leucocytic or round cell infiltration and no evidence of absorption of the transplant (Le is and Dr is).

third week after transplantation. They are quite marked however as late as five weeks. They are due to proliferative changes in the tissues surrounding the transplant in the peritendineum externum and internum as well as to an oedema in the transplant resulting from an imperfect re-establishment of circulation. While some regressive changes occur in all transplanted tendon segments as evidenced by some of the fibrillae undergoing hyaline degeneration the transplant as a whole remains viable. The transplanted segment does not act as a bridge to convey tenoblasts from the proximal to the distal end of the resected tendon and the formation of new tissue in a transplant when it has undergone some regressive changes takes place from the tissues of the transplant itself.

The differences in behavior between pieces of tendon transplanted into a tendon defect or into subcutaneous fat cannot be due to differences in nourishment for tendon transplanted intramuscularly or subcutaneously has as favorable conditions provided for its nourishment as that transplanted into a tendon defect. The real difference it seems to me is that in one instance the tendon as



FIG. 5. Longitudinal section of peroneus profundus tendon transplanted into the subcutaneous pocket of the abdominal wall. Tissue removed 35 days after transplantation. (L. S. and L. D.)

sumes early the function for which it is intended while in the other it is permitted to undergo an atrophy quite comparable to disuse atrophy which eventually ends in death in absorption.



FIG. 6. Longitudinal section through tendon three weeks after transplantation. The fibrous and cellular areas are well and appear practically normal. There are some profuse changes in the peritendoneum. (L. S. and L. D.)

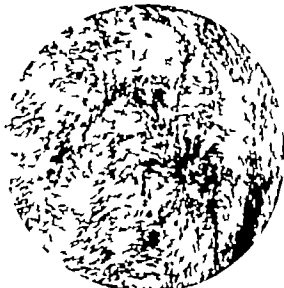


FIG. 7. Cross section through peroneus profundus tendon transplanted into the subcutaneous fat and removed after five weeks. The cross section of tendon reduced considerably in size. There is considerable leukocytic infiltration in the areas. Neither the fibrous nor the cellular areas show any changes. These defects regenerate changes remarkably due to the fact that the peroneus profundus tendon has not been made to assume function. (L. S. and L. D.)

Fasciata tendon and the same changes occur in it as in a tendon transplant but to a less extent. I believe that it is preferable to tendon for transplantation in the repair of tendon defects because it can be obtained in such large amounts and removed without interfering with function and in the repair of extensor tendons the strip can be made to correspond in size and form to the tendon to be repaired.

As the repair of tendons is usually required after extensive burns, lacerations or infection associated with much scar tissue the transplantation of a flap of skin containing considerable fat is usually first required. In the repair of extensor tendons it is best to transplant a flap from the abdomen containing considerable fat. I have taken the entire thickness of the fat sacrificing cosmetic for functional results which are more certain when this amount of fat is taken. Fasciata transplantation is not attempted until the flap is entirely healed. Then the fat is tunneled through with artery forceps so that the transplant will run through a fatty tunnel.

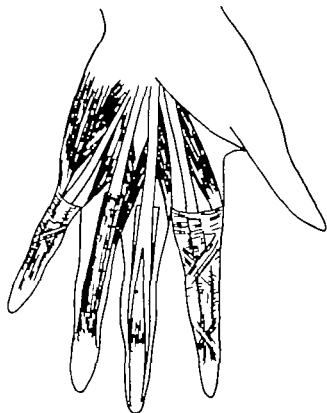


Fig 8 Diagrammatic sketch to show tube made from fascia lata which surrounds the proximal ends of tendons to be repaired and is attached distally to the periosteum of the phalanx

As previously stated early assumption of function is of prime importance in securing functional results and active motion should be encouraged as soon as the patient can undertake it. This is rarely possible before two or three days because of the pain associated with motion. The suture that should be used in such cases must hold the ends well approximated when the muscles are thrown into action and must not strangulate the tissues. The suture introduced by Frisch answers the purpose better than any I know of. Kimura has demonstrated experimentally the strength of different types of tendon sutures. He found that the Frisch suture never tore out when the weight was below 355 ounces and that it withstood considerable traction from 3 to 15 hours while the other types of tendon suture never withstood a weight much less than this over two hours.

The results following the repair of flexor tendons are not as satisfactory as those following the repair of the extensors. The pull of the flexor tendons is greater than that of the extensors and they are grouped so



Fig 9 Tendon which formed following operation. The finger was amputated 255 days after the fascial tube was inserted. The fascia remains intact forming a sheath for the tendon which has developed from the proximal end of the flexor sublimis and profundus tendons. The two tendons separated by a thin connective tissue septum can be distinguished in the tube.

much more closely in the palm than slight adhesions may interfere seriously with function. The technical difficulties are also increased when the transplantation is carried high into the palm.

I have attempted fascial transplantation in the repair of tendons when the skin on the

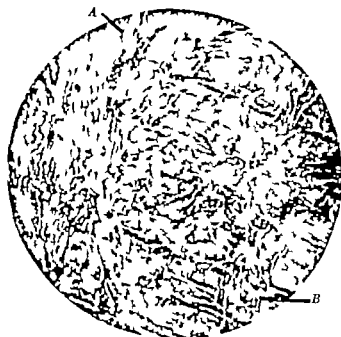


Fig 10 Cross section of the tendon. The fascia wall preserved and resembling normal fascia forms a sheath for the tendon which has developed. There is no evidence that the fascial tube plays an active part in the formation of tendon. It forms merely a canal along which the tendons of the divided tendon proliferate. A Section through transplanted fascia. B Section through tendon. The fat which lined the inner side of the tube and which would if it was hoped form a sheath has disappeared.

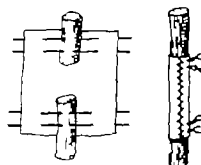
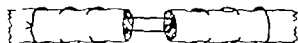


Fig. 1. Diagram illustrating the method of construction of the artificial nerve. The peripheral ends of the tubes are connected by a network of fine threads, forming a continuous circuit. The tubes are shown in cross-section, with the internal structure visible. The text is partially obscured and difficult to read, but it appears to describe the construction of an artificial nerve or a similar biological structure.

I have had the opportunity of examining the fate of a fascial tube which was inserted for the repair of the flexor tendons of the ring finger. The patient who was a physician had been bitten by a pituit upon the ring finger of the right hand fourteen months before entering the hospital. A severe infection developed so that thirteen days after the injury the terminal phalanx and a part of the middle phalanx with the flexor tendons



Fig. 2. Section of the part of the fascial tube, showing the formation of a new nerve. The image shows a dense network of fibers and cells, with some larger, more rounded structures that may be nuclei or other cellular components. The text is partially obscured and difficult to read, but it appears to describe the formation of a new nerve or a similar biological process.



Fig. 1. Section of peripheral part of regenerated intermediate nerve, one half inch after operation showing formation of myelin sheath in the fat tissue of complete nerve repair (Kirk and Lewis).

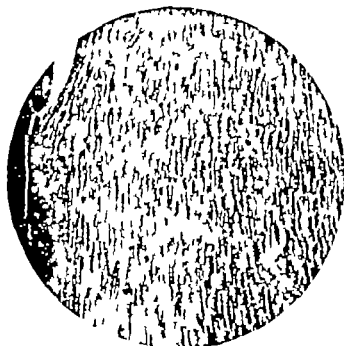


Fig. 2. Distal segment of resected nerve seven weeks after operation showing an unit of innervation of this segment by axon cylinders which have entered the gap (Kirk and Lewis).

had to be removed. The wound continued to discharge for two months. At the time I first saw the patient scars were present upon the anterior and posterior surfaces of the ring finger which extended to the middle of the hand and down to the proximal transverse fold. The ends of the flexor tendons could be felt.

I attempted to reconstruct these tendons by means of a fascial tube. A piece of fascia including a layer of fat measuring about 3

inches in length and one half inch in width was removed from the fascia lata of the right thigh. A flap was then dissected up from the

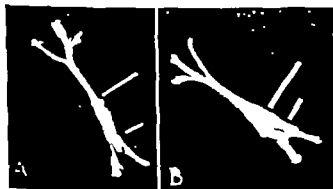


Fig. 3. (A) Appearance of nerve removed seven weeks after fascial tubulization to repair a defect, reduced one half. Lines indicate approximate extent of fascial tube. (B) Same specimen divided longitudinally. Lines in fascial tube in longitudinal extent of form (Kirk and Lewis).



Fig. 4. Histologic appearance of fascia sixteen and one half weeks after tubulization. This fascia has undergone no electrical change and is in the same condition as when transplanted. After this length of time no contraction or replacement of the fascia is to be expected (Kirk and Lewis).



Fig. 1. Nerve. Fig. 2. Direct fat transplantation. Fig. 3. Tendon. Fig. 4. Tendon. The external joint is delimited by the lines composed mostly of articular tissue. Resection of the ends of the tendon is therefore indicated. By flexion of the knee the resected end could be approximated without tension. A fat transplant was used to protect the suture line against contracture. Fat is offered to the tendon by the latter undergoes contracture in the presence of scar. The joint of the hand which neurolysis indicated there considerable carpal tunnel.

palmar surface of the finger the incision being carried through the interdigital fold into the palm of the hand. The ends of the tendon were dissected free from a dense scar in which

they were imbedded and a fascial tube was formed which surrounded the ends of the tendons on the proximal side and was prolonged to the periosteum of the middle phalanx

distally. The side of the fascia holding the fat was made the inner side of the tube. Active motions were encouraged at once but these could not be carried out at once because of the pain associated with them. After some weeks the patient could flex the finger to about  $80^{\circ}$  when the newly formed tendon was held against the bone. The results were not entirely satisfactory however and nine months after this operation I amputated the finger. A newly formed tendon was found both the flexor sublimis and flexor profundus separated by a septum having proliferated down the tube. The fat which formed the inner side of the tube had been absorbed so that the newly formed tendon was adherent to the fascia which was fully preserved and did not differ histologically from fascia recently removed.

One of the reasons why the results attending construction of the flexor tendons are not as good as desired is that at the present time we have no satisfactory method of reconstructing the transverse bands which are usually destroyed in the cases requiring tendon reconstruction. In the case of fascial tube reconstruction just cited considerable impairment of function was caused by the newly formed tendon leaving the bone each time flexion was attempted. The patient soon discovered that he could greatly increase the amount of flexion by holding the tendon against the bone when flexion was attempted. Rehn has encountered the same difficulty after transplantation of tendon to repair defects in the flexor tendons. When a ring is worn holding the transplanted tendon down to the bone the amount of flexion is greatly increased.

McArthur has employed a method in the preparation of a fascial transplant which I believe is of distinct value as it will lessen the frequency with which secondary tenolysis has to be performed. This procedure tends to render the fat over the fascial transplant more suitable for transplantation. In the plan advised by McArthur an attempt is made to cover the transplant with condensed closely adherent fat. The fascial strip which is to be transplanted is first dissected up but is left attached at both ends. Subcutaneous

fat is then placed about this fascial strip and the wound is closed leaving the fascia with the fat about it lying in its bed. Six weeks later McArthur reopened the wound in the thigh and found the fascial strip covered by abundant closely adherent fat. The fascial and fat transplant was then transferred to the forearm and sutured to the flexor muscles above and the tendons below. In this case the greater part of the bellies of the flexor muscle had been destroyed by a corn shredder. The results in this case may be considered extremely good. The fingers cannot be flexed individually but the function of the hand is so much improved that the patient can grasp a pitchfork and work about the farm.

Fascia may be used to advantage in the treatment of paralysis. It may be used as a tendon to transfer the action of an active muscle to a paralyzed part and may be used to fix a muscle to overcome a deformity dependent upon paralysis. Three cases have been reported in which fascia has been used to correct a ptosis. The fascial strip has been attached above to the active frontal portion of the occipito frontalis and has been passed beneath the skin of the eyelid and sutured to the tarsus. Two of the results (Pavv and Muehsam) were apparently successful. In Aizner's case the operation being performed for correction of congenital ptosis the fascia apparently underwent cicatricial contraction for after six months there was some lagophthalmos and the lid space had considerably widened. Lewis and Davis have reported a case of trapezius transplantation in which the trapezius after being separated from the acromion and spine of the scapula, could not be brought down as far as desired upon the humerus. A wide fascial strip was sutured to the trapezius above and into the humerus below the arm being held and dressed in abduction at  $90^{\circ}$ .

Payr in a case of deltoid paralysis split the upper part of the trapezius and sutured fascia to it. The fascia was then sutured to the long head of the biceps below and was fixed over the joint. Rothschild and Cramer have both used fascial transplantation successfully in the correction of trapezius paralysis.



Busch has used fascial transplantation in the correction of facial palsy by the so called suspension method. In order to correct the drooping of the angle of the mouth the skin of the cheek is undermined and a fascial strip which is passed beneath it is sutured to the muscles of the angle of the mouth and is fixed above to the periosteum of the zygoma. In a case of facial palsy operated upon by Payr two strips of fascia were used. One piece was fixed above to the infra orbital margin the other piece was sutured to the temporal muscle. An excellent result was obtained when the facial muscles were at rest but no mobility or expression was obtained through the strip attached to the temporal muscle.

#### FASCIA TRANSPLANTATION IN REPAIR OF NERVE DEFECTS AND FOR NEUROLYSIS

A study of nerve injuries abundant opportunities for which have been offered by recent wars has shown that in many cases in which paralysis has developed the nerve has not been completely severed. It has been contused or grooved and the functional disturbance which results is often due to the contraction of cicatricial tissue within or about the nerve. Loss or alteration of function may be due to the secondary involvement in callus or to the stretching over bony points in cases in which nerve is associated with bone injury. A scar fixing a nerve over a bony point may cause marked functional disturbance. In some of these cases paralysis develops late. Paralysis developed in a patient of Borchart two years after the removal of dead bone from the shaft of the humerus. In many of these cases freeing of the nerve from the scar is enough to secure return of function providing the scar can be prevented from reforming.

That neurolysis may be decidedly beneficial is indicated by the cases observed by Hashimoto during the Russo Japanese war. But four nerve sutures and three nerve transplantations were attempted in the fifty cases operated upon and observed by him. The results of the three cases of nerve transplantation were unsuccessful. In 45 cases neurolysis was attempted. The results were

very good in 11 cases, good in 15 satisfactory in 3 questionable in 4 and unsatisfactory in 11. In 7 cases neurolysis was attempted 300 days or more after the injury. In this series the results were good in 4 cases questionable in 1 and unsatisfactory in 2. In 45 cases treated by neurolysis good results were obtained in 65 per cent or if the 4 questionable cases are included in 74.4 per cent. The results obtained by neurolysis after 200 days had passed from the time of injury were doubtful.

Many different materials have been used for tubulization after neurolysis. Material used for this purpose must be capable of good sterilization must not act as a foreign body and must not contract adhesions with the nerve. Decalcified bone tubules iodoform gauze hardened human blood vessels human epidermis magnesium tubes hardened blood vessels of calves have all been used. Hashimoto used calves arteries hardened in formalin after the method of Foranitti. In one case reported by Hashimoto amputation became necessary four months after tubulization with a hardened artery was attempted. The hardened blood vessel was almost entirely absorbed only a few elastic fibers remaining in some places. Where at the first operation a white avascular cicatricial thickening was found there was at the second operation a soft reddish segment abundantly supplied with blood vessels.

Recently there has been considerable discussion against the advisability of using fascia for neurolysis. Kredel has been particularly emphatic against its use because of an experience he had in which the fascia was applied directly about a scar in a nerve. Contraction occurred in the transplanted fascia necessitating a second operation. But few cases have been reported in which fascia has been used for neurolysis. I have operated upon one case in which the musculospiral nerve was resected and sutured the line of suture being covered with a fascial transplant. There has been almost complete return of function without any interference in function from contraction. Law has recently reported two cases of brachial plexus injury in which the line of suture was covered with free fascial

laps. There has been continued improvement in these cases with no evidence of cicatricial contraction of the fascia. Rowan in a recent personal communication relates the history of an ulnar nerve suture combined with fascial tubulization in which there has been a complete return of function. Against these successes may be mentioned the cases of Kredel and Goldmann. Goldmann placed fascial strips about the median and ulnar nerves. After six months the nerves had to be exposed because of impairment of function. The fascia was then found to be firmly adherent to the nerves.

Experimentally fascia may be used successfully to bridge a defect in nerves and the results which follow experimental tubulization would indicate that fascia may be used for neurolysis providing the scar is resected. If placed about a recent scar fascia contracts. This contraction as well as that which occurs in fascia placed about peritoneum is I believe not inherent in the fascia proper but is secondary to the scar existing when the fascia is placed about the nerve.

Kirk and Lewis have examined 41 sciatic nerves of adult dogs 21 of which were sectioned serially in which fascia has been used to tubulize a defect. The nerves were examined at periods varying from 1 day to 36 weeks after the operation. In none of these did the fascia forming the tube undergo cicatricial contraction. In some of the late stages the fascia had become so thinned that it was scarcely distinguishable from perineurium.

The changes occurring in a fascial tube used for this purpose would seem to be conducive to cicatricial contraction. During the first day the tube is filled with a serous exudate. If hemostasis has been adequate the exudate contains few or no red cells. At the fifth day the portions of the tube nearest to cut ends are filled with a soft grayish white pulpy material resembling brain matter. This exudate comes from the nerve ends the fascia showing no reaction. Even as late as the fourth and fifth days the middle of the tube may be empty. Experimentally this tube does not collapse and an excellent opportunity is afforded for the study of re-

generation of nerves after tubulization. One of the most striking things revealed by the study of nerve regeneration by this method is that protoplasmic band formation precedes the downgrowth of axis cylinders from the central end and that while protoplasmic bands develop from both ends of the resected nerve axis cylinders develop only from the proximal end and enter the bands which act as conduits for the developing axis cylinders. The approximate rapidity of growth of the bands is indicated by the fact that after removal of a segment of a nerve measuring 12 millimeters in length the protoplasmic bands have completely bridged the lumen of the tube by the sixth day. The bands are very numerous near the proximal end of the nerve at this time much less numerous at the distal end and least numerous at a point about 10 millimeters from the proximal end of the resected nerve. This indicates that while protoplasmic band formation occurs at both ends the formation is much more active at the proximal end and that the bands forming here grow much more rapidly.

In the late cases examined by us as late as 36 weeks there has been no cicatricial contraction which would undoubtedly have occurred after this length of time if such were to take place. The transplanted fascia has in some instances as previously stated become almost indistinguishable from the perineurium. Von Fleischhauer in his clinical observations has found that a cicatrix in a nerve usually undergoes contraction seven or eight weeks after an injury. Fascia cannot be successfully used for neurolysis when it is placed about a scar or in a bed of scar tissue but it may be used successfully to cover a line of suture in a nerve and has been so used by both Law and Lewis.

#### FAT TRANSPLANTATION IN TENOLYSIS AND NEUROLYSIS

Several objections have been raised against fascia for purposes of neurolysis and tenolysis. As stated above Kredel and Goldmann were compelled to perform a second operation in cases in which fascia had been placed about a nerve. Cicatricial contraction of the fascia the formation of broad firm adhesions be-

tween the nerve and the fascia and fatty degeneration of the fascial transplant with infiltration limit considerably the use of fascia for both neurolysis and tenolysis. Under appropriate conditions fascia may be used for both purposes but often extensive scars are encountered when these operations are performed and the use of fascia is therefore limited.

Experimentally it has been shown by histologic examination that transplanted fat heals in position with extremely little or no reaction of the foreign body type. There is but little leucocytic infiltration. In the early stages transplanted fat becomes adherent to nerves about which it is placed. During regeneration of the fat the adhesions become less and less and the fat either merely surrounds the nerves or is separated from it by a connective tissue zone of microscopic width. Eden and Rehn believe as a result of their experimental studies that no other autoplasmic transplantable material contracts as few adhesions with tissues about which it is placed as fat.

Because of these properties fat can be transplanted in a much larger proportion of cases of neurolysis and tenolysis than fascia for in most cases in which the operation is indicated there is considerable scar tissue. In tubulizing for the repair of nerve defects in which there is considerable scar formation it is well to take considerable fat with the fascia the fat being placed upon the outer side of the tube.

#### CLOSURE OF DURAL DEFECTS

Most of the attempts which have been made to close dural defects and to prevent scar formation in the cerebral cortex by the use of foreign material have been unsuccessful. The two best materials which have been used to close dural defects are fascia and peritoneum autoplasmic transplants being used. The same changes occur in both after transplantation and also in the brain cortex after their use. The results of experimental work in dural plastics vary. Saar found adhesions between the fascia and pia arachnoid in many of his experiments. In seven of the ten cases examined by him more or less

extensive adhesions were found. It seemed to be the rule that in all cases in which the brain was traumatized adhesions formed between it and the fascial transplant while in cases in which the brain was not injured a space was found between the transplant and brain cortex. In some cases the fascia was covered by endothelium.

Up to 1914 73 cases had been reported in which fascia lata had been used to close a defect in the dura.

This type of plastic operation was performed for —

Traumatic epilepsy	14
General epilepsy	
Brain tumor	3
Dural tumor	5
Recent compound skull fracture	3
Simple skull fracture	2
Old depressed fracture	3
Gemma of the brain	1
Meningocele	1
Character of injury or disease unknown	2

In 7 of the 73 cases cerebrospinal fluid escaped after the operation. In 5 of these the escape of fluid ceased after a few days. Haberer operated upon a traumatic cyst of the brain in which almost the entire wall of the lateral ventricle was removed and replaced by fascia. Cerebrospinal fluid escaped for one day after this and then the discharge ceased. In one of Eiselberg's cases the discharge of fluid persisted for ten days at which time the patient died.

In six of the cases the brain prolapsed. In two of these the prolapse occurred after the fascia had been perfectly transplanted. In three the prolapse was probably due to an infection which developed. In one case it was impossible to completely replace the brain after the dura had been removed and technical difficulties prevented the proper insertion of the fascia.

In none of the cases has enough time elapsed since the operation to permit one to speak positively of the results.

But few opportunities have been had to examine fascia which has been used to close a dural defect in man and the case reported by Rehn is therefore significant for it indicates what procedure must be followed if the results are to be improved.

The patient a male 27 years of age had

epilepsy and after removal of a considerable piece of dura which was under pressure the defect was closed by a fascial transplant. Because of a recurrence of symptoms some five months after the operation a second operation was performed. The bone flap which was not closely united was turned down and the fascial transplant was then found to be closely adherent to the surface of the brain. A distinct difference between the central and peripheral part of this transplant could be made out by the naked eye. About the periphery the fascia had retained its histological characteristics but toward the center of the transplant fewer well stained nuclei were found phagocytes loaded with pigment became more numerous and gnarled rolled up bundles of degenerating fibrille rather sharply delimited from the adjacent living fascia were seen. The dense adhesions which had formed between the brain cortex and the fascial transplant were apparently the result of necrosis in the central part of the fascia which ended in fatty degeneration followed by cicatricial substitution.

While fascial transplantation closes effectively a dural defect preventing prolapse of the brain and probably reducing somewhat the chances of infection, it does not fulfill the purpose for which it is frequently employed of preventing adhesions. This has been demonstrated experimentally and clinically. Fat forms much less dense and fewer adhesions and for this reason it is advisable that when a dural plastic becomes necessary a layer of fat be included with the fascia and that the fat be placed toward the brain cortex. If adhesions do then form they will be more delicate and pliable than those associated with any other type of dural plastic.

I have operated upon three cases of epilepsy following trauma in which a subdural cyst was found. In these cases the scar which had replaced the dura and formed the outer wall of the cyst was removed. The cavity of the cyst was then filled with a fat transplant and the dural defect closed with a fascial transplant. In two of these cases the seizures have been reduced in frequency and severity, while in the third case no improvement has been noted.

#### RECONSTRUCTION OF COMMON BILE DUCT AND URETER AND STRENGTHENING OF SUTURE LINES

With the idea of determining the amount of resistance that fascia might have against certain body excretions Davis and Lewis attempted to reconstruct the common bile duct with a free fascial transplant. Attempts were made to bridge gaps in the common duct, and to patch partially severed ducts. In all cases the gastrohepatic omentum was destroyed in so far as any support was given the common duct. In one series of cases the common duct was cut across and the ends allowed to retract until they were one half to one inch apart. A strip of fascia was removed from the rectus muscle passed beneath the duct, fastened by silk sutures to the proximal portion of the common duct and passed well up on the cystic and hepatic ducts. The repair of the distal end was done by fixing the fascia behind the duodenum behind the entrance of the distal end of the duct into the intestine. The fascia was then folded to form a tube and two continuous sutures were used to make the caliber as tight as possible. Over this the omentum was wrapped as an extra precaution.

In the second series the common duct was cut partially across and then slit lengthwise for one half inch a strip of fascia from the abdominal wall was placed around the duct and the abdomen closed without drainage. In 11 cases it was necessary to close the abdomen without drainage as the animals pulled out tubes and gauze in the first 24 hours. In some cases an attempt was made to divert the bile from the field by draining the gall bladder. The animals died from the escape of bile into the abdominal cavity after the tubes had been removed by them. Leakage rendered the experimental results nil. Three dogs in which the duct was cut lived two months. Two when killed had a patent common duct and the stools were normal in color. The third dog which lived 65 days had a constriction on the intestinal side of the common duct and the duct above this point of constriction was enormously distended. The fascia was alive however. In one dog in which the duct was cut longitudinally the fascia was sutured too tightly at the duodenal

end but even in this case the fascia was alive and strong enough to retain bile

Strauss has demonstrated experimentally that fascia will live in the presence of urine even when infected. A peculiar ossification of the transplant occurs in the cases in which fascia is used to bridge an ureteral defect. The lumen of the tube is preserved in spite of this ossification but the ossified segment may interfere with the flow of urine because of interruption of the peristaltic wave. Fascia may be used to reinforce a suture line of the ureter and one case is reported in which fascia had been placed about a repaired ureter and prevented extravasation of urine after the sutures gave way.

Fat has been used extensively to reinforce suture lines in gastro intestinal surgery. Braun was the first to use a pedunculated omental flap to reinforce the suture line over a perforated gastric ulcer. Senn early advised the use of omental grafts free or attached to reinforce the suture line in gastric and intestinal surgery. In closing perforated gastric ulcers the suspensory ligament can often be used to reinforce the suture line for the perforation frequently occurs close to this ligament.

Fascia although advised by Koenig and others to reinforce the suture line in intestinal surgery cannot be used for this purpose because of its tendency to undergo cicatricial changes leading to constriction of the intestine or the formation of adhesions with neighboring loop. It is interesting to note however that defects of the intestinal wall which have even included the mucosa have been closed by a fascial patch. The intestinal mucosa has proliferated in some of these cases so that the inner surface of the fascia has become covered with epithelium.

As fat and fascia can be transplanted with such a fair degree of certainty both probably have been used in many instances in which there is no necessity for the use of these materials. The use of both fat and fascia after pyelotomy is of doubtful value for it has been my experience that the wound in the pelvis soon heals and besides stitches about the pelvis after the removal of a stone may form the nucleus for a new one. Pavr has

used successfully in pyelotomy a pedunculated flap from the fibrous capsule of the kidney. If the capsule is so thin that a flap cannot be easily made a free fascial transplant may be used or a fat transplant.

While free fascial transplants have been used in fixation of the kidney and in orchidopexy I doubt the necessity or wisdom of employing fascia for these purposes. Because of the size of the transplant required in kidney fixation fatty degeneration of the transplant with subsequent cicatricial contraction is apt to occur and the testicle can be usually placed in the scrotum if the shortened vessels are resected and the bands of fibrous tissue which hold the testicle in the inguinal canal are freely severed. In cases in which the testicle cannot be placed in the scrotum after these procedures and maintained there by a purse string suture passed about the entrance to the scrotum I doubt the advisability of attempting to save the testicle.

#### TRANSPLANTATION OF FAT FOR COSMETIC PURPOSES

It has been stated in discussing tenolysis and neurolysis that the strips of fat usually used for these purposes remain viable. While certain changes occur leading to absorption or liberation of fat droplets collections of other groups of cells probably derived from the original fat cell are found which indicate definite growth changes so that the term of growth atrophy may not be inappropriately applied to the changes in the fat following transplantation. The possibility of transplanting large masses of fat widens considerably the field of plastic surgery. Cerny was probably the first to attempt the transplantation of large amounts of fat. He reported to the German Surgical Congress in 1895 a successful transplantation of a lipoma to replace a breast which had been removed. Neubauer soon after reported cases in which he had transplanted fat subcutaneously to raise a depressed scar over the infra orbital margin resulting from an earlier tuberculous osteitis. His attempts to transplant large pieces of fat all failed and he came to the conclusion that pieces of fat which exceeded in size a bean or almond could not be successfully transplanted.

The use of fat to fill bone cavities resulting from osteomyelitis has been frequently attempted and as is the case with most operations designed to do this the final result depends upon the amount and virulence of the infection. If the cavity can be so cleaned that the chances of infection are greatly reduced or removed fat may be used to fill the cavity but the experience with fat transplantation in the closure of osteomyelitic cavities is much like that with the Mosetig Moorhoff plug and Beck's paste.

Tuffier has used fat transplants to cover the end of the bone after amputation of the femur, after resection of an elbow joint, etc. In two cases he attempted to close an empty cavity by transplanting a lipoma, while in a third he transplanted a piece of omentum which had been kept on ice.

But few attempts have been made to use fat to correct deformities about the face. Bier operated upon a facial hemiatrophy and

increased the size of the half of the face affected by inserting strips of fat removed from a lipoma beneath the skin. Neuber used it to raise a depressed scar over the frontal sinus, Kanavel to correct an unsightly scar of the chin which followed ulceration following the application of arsenic paste.

Ophthalmologists have used fat transplantation both after enucleation and evisceration of the eye. All of the uses to which fascia and fat transplantation have been applied have not been touched upon. I have attempted to give some of the underlying principles. The use of fat or fascial transplantation in arthroplasties has recently been the subject of much discussion and their value demonstrated. The use of fascia to occlude intestinal loops in gastro intestinal surgery and to produce temporary closure of vessels in the treatment of aneurism has been tried out sufficiently to determine its distinct value in these fields of surgery.

## FASCIA AND FAT TRANSPLANTATION<sup>1</sup>

By FRANCIS T. STEWART, M.D., PHILADELPHIA

MY experience in transplanting fascia and fat has been limited by lack of confidence first, on my part second on the part of certain of my patients. My distrust in the survival of completely detached portions of fat and fascia was most acute when I first heard of these proceedings and it was not until after I had seen notably in connection with arthroplasty broad sheets of fascia transferred from the thigh to other parts of the body and there retained for months without suppuration that I was willing to venture into this field of plastic surgery. Even after obtaining success in my initial ventures I still hesitated to recommend unconditionally what was to me a new and scarcely tried procedure hence the lack of confidence on the part of my patients. I told them what I wanted to do and that I was uncertain of the result consequently many of them refused to submit to what

they justly regarded as an experiment. I and they still assume this attitude in regard to the formation of tendons from strands of fascia, so that although I have expressed a willingness to try to make new sinews for a number of maimed patients none has consented to participate in the trial. Concerning most, but not all of the other purposes for which free fascial transplantation has been suggested I am in agreement with the authors of those suggestions and after what I have heard tonight my opinion must, necessarily become more positive in the direction of the efficacy of neotenyoplasty.

Altogether I have transplanted completely detached pieces of fat, fascia, or fat and fascia about 100 times. In only 5 cases was there suppuration of the wound in which the graft was imbedded. In one of these a case of inguinal hernia in which operation had already been done several

times the hernia again recurred. In two others cases of arthroplasty a slightly movable joint was obtained despite the formation of pus. In another a case of congenital fragilitas ossium with an ununited fracture of the femur the femur united. In this case the fascial graft was wrapped about the femur to maintain in place a trap door in the bone which had been elevated in order to permit the introduction of an intramedullary splint. In another case one of closed tuberculous osteomyelitis of the calcaneum in which the diseased bone was replaced by fat a minute sinus formed and still persists at the end of a month. In several other cases a small quantity of serum was evacuated from the wound without however delaying its closure. Hence one may conclude that in a specified operation e.g. operation for hernia arthroplasty the danger of acute necrosis of a free transplant is little or no greater than the danger of suppuration in the same operation without free transplantation. This point should be emphasized since there are still many surgeons who are skeptical as to the benignity and the value of this form of reparative surgery.

In five of my cases the graft or the site of the graft was seen sometime after the operation. Once in the case of fracture previously mentioned it was discharged as a slough. Once in a case of incisional hernia in which death from uræmia occurred a week after operation it was found only partly and slightly adherent to the tissues of the abdominal wall it being separated from these tissues in some places by a collection of serum. Once in a case of suture of the carotid artery followed by a large hematoma it was removed on the second day in order to inspect the sutured wound in the artery which was found to be dry, the bleeding having proceeded from one of the stitch holes that had been made in fastening the graft to the artery. In this case the grafting produced the very condition it was designed to prevent. Once in a case of graduated ligation of the carotid artery for pulsating exophthalmos the transplant with the artery which it enveloped was removed at autopsy

three months after operation the patient having succumbed to an acute nephritis. Macroscopically the transplanted fascia was firmly adherent to but could be differentiated from the arterial wall. The microscopist report states that there is a very dense fibrous tissue which is probably the transplanted fascia. Apparently exterior to it is granulation tissue showing considerable lymphocytic infiltration and containing many multinucleated giant cells. This granulation tissue only slightly invades the fascia. The fascia is poor in cells. Apparently there is partial death of the fascial cells. Once in a case of pyloric occlusion with a fascial graft the pylorus was inspected at the end of 18 months during the course of a second laparotomy and found to be imbedded in firm adhesions and apparently non-patulous.

In about one half of my fascial transplantations the operation was undertaken for the relief of inguinal or ventral hernia.

In those varieties of inguinal hernia in which the usual operations give only mediocre results e.g. large hernia recurrence hernia direct hernia sliding hernia fascial transplantation would seem to promise a distinct amelioration in those results and be superior to the implantation of foreign substances which not unfrequently give rise to trouble later and to the borrowing of fascia or muscle from the margins of the defect which necessarily results in a weakening of those marginal structures. Furthermore when attached flaps are taken from the immediate neighborhood of a hernial ring they cannot be swung into the plane in which they would be of the greatest benefit i.e. between the transversalis fascia and the peritoneum. This is the point at which a recurrence usually begins and having once begun is seldom restrained by the overlying planes of tissue even though these planes have been overlapped or otherwise reinforced. When a fascial transplant is sutured on the exterior of the muscles it is at once to use a military term outflanked by the recurrence which follows the line of least resistance along the cord and appears at the external ring. A further advantage of placing the graft beneath all the muscular and fascial layers

is that it is more likely 'to take'. It should never be placed immediately beneath and in contact with the cutaneous incision in which situation it is more apt to become infected and suffer elimination. When only a small transplant is desired it can be obtained from the fascia lata just below the outer end of Poupart's ligament between the anterior crural and the external cutaneous nerves after undermining the lower lip of the cutaneous incision. When a larger and thicker piece is necessary however it is better to make a separate incision over the trochanter of the femur. This principle of submural implantation I have followed also in dealing with ventral hernia suturing the graft beneath the transversalis fascia or particularly in the upper abdomen in which region separation of the peritoneum from the transversalis fascia is sometimes tedious beneath the peritoneum. I believe it to be advisable to remove all fat from the graft when it is to be interstitial thus encouraging prompt and firm adhesions to the tissues between which it is placed and to leave the fat and turn the fatty side toward the viscera when the graft is to be placed beneath the parietal peritoneum thus discouraging adhesions to the under surface of the graft. If the fat is to be removed this should be done before the graft is excised otherwise the graft is subjected to increased handling and its journey from its old to its new habitat prolonged thus violating two of the principles of this form of surgery viz minimal brutalization and rapid transportation.

For the purpose of maintaining a near thrombus non absorbable non foreign fascia is surely superior to non absorbable foreign

substances (silver zinc, celluloid rubber), which are so often discharged by suppuration and also to absorbable substances (magnesium Cargile membrane chromatized pig's bladder) which are objectionable because they are absorbed thus permitting the osseous surfaces again to come in contact. However I believe that for a successful result as much depends upon the liberal removal of bone and early motion as upon the interposition of any material.

For enveloping a nerve after neuorrhaphy or neurolysis fat and not fascia should be employed. Fascia generates more adhesions it also shrinks and compresses the nerve.

Fascia offers a staunch material for reinforcing the suture line after angiorrhaphy but is probably inferior to muscle as a hæmostatic agent. If one desires both the firmness of fascia and the thrombokinetic influence of muscular tissue a transplant composed of fascia on one side and muscle on the other can easily be obtained. For the gradual obliteration of a large artery e.g. common carotid aorta a tight and almost occlusive primary wrapping of the vessel with fascia to be followed at a later period by definitive ligation is to be preferred to increasing compression by metallic foreign substances.

At first I occluded the pylorus with a free transplant of fascia from the rectus abdominis, but now use the round ligament of the liver.

The largest amount of fat that I have transplanted was to restore the contour of a breast after the removal of a massive fibro adenoma. A year later the transplant was slightly smaller more firm more granular but the cosmetic result remained unaffected.



## SURGERY OF THE PERIPHERAL NERVES

B. C. A. PORTER M.D. F.A.C.S. BOSTON

IN preparing this short paper I have studied 187 cases of peripheral nerve lesions which have entered the Massachusetts General Hospital since 1900 or have occurred in private practice. With the exception of a few interesting neuritis cases and old facial paralyses the origin of the nerve lesions was traumatic. For many years I have been much interested in this subject and in consequence find that I have personally performed more than half the total number of operations. The series covers every peripheral nerve except the cutaneous branches and includes the short saphenous, facial, lingual and spinal accessory. Before attempting any analysis let me first present the material and the end results so far as they have been obtained.

*Facial paralysis.* In 4 cases attempts at suture were made: 1 primary after a razor cut with unknown result; 1 six months after a pistol wound; suture of the eleventh to the seventh nerve; no improvement. The third complete paralysis thirteen years after a convulsion. The facial was split and a slip of the hypoglossal placed in the niche. Fifteen years afterward there is partial recovery. In the fourth case following a mastoid operation two years before the facial was anastomosed to half of the hypoglossal. Ten years afterward there are weak voluntary facial movements though faradic response is good. One half of the tongue is atrophied and the speech somewhat thick. I have had no personal experience with this operation and shall therefore leave to Dr. Frazier the discussion of the best technique in this anastomosis. In my series there is another type of facial paralysis either congenital or very ancient from 19 to 36 years in which all the muscles are permanently atrophied and nerve suture is useless. I have accomplished marked improvement by crescentic incisions of skin and fat over the malar bone taking up the slack with buried silk sutures. Later a second resection is performed the scar to

fall in the nasolabial fold well beyond the angle of the mouth. The redundant mucous membrane is removed from the inside of the lips and sutured out of sight. I strongly recommend this operation for all cases of facial paralysis where anastomosis is impossible or unsuccessful.

Turning next to *brachial plexus lesions* we come to a most discouraging subject. As I have never had an opportunity to operate for birth palsy I shall limit myself to accident cases. There are three types: the upper arm or Erb; the lower arm or Klumpke; and complete paralysis depending upon whether the force has crushed the shoulder downward, motor cycle or coasting accidents; or the arm has been caught in a belt and jerked violently upward. There have been 17 cases in which operation was not advised or was refused; 1 case combined with subclavian laceration died within 48 hours. In others lesions of the sympathetic or a probable coexistent lesion in the cord suggested an inoperable condition. In some cases of gunshot injuries or dislocation of the shoulder it seemed best to await developments. In several instances of the upper arm type with a fairly useful hand exploration was refused by the patient. There were 21 cases in which some sort of an operation was performed; 18 of them by myself. In September 1901 Dr. Mixer performed the only primary suture of the whole plexus; a cut from broken crockery. The man disappeared after discharge. All combinations of lesions have been found. An absolutely inoperable condition where the nerve roots of the plexus have been completely torn from the spine or the fifth and sixth roots ruptured and torn backward or the inner cord had borne the brunt of the injury requiring resection of the clavicle for adequate examination. In 1 case operated upon in 1903 four months after the accident all of the cords found hopelessly blended in a mass of scars were excised and an entirely new plexus constructed which would defy a

professor of anatomy In this case flexion of the wrist first began three years after operation improvement continued and now while there is flexion of the arm wrist and fingers and some power in the triceps the extensors are paralyzed In three cases amputation of the shoulder was demanded by the patient In 9 the plexus was dissected free the scars were incised and cargle membrane fat or fascia was used to prevent adhesions

The average time from accident to exploration was five months the longest three and one half years Upon exposing the brachial plexus the surgeon is confronted with a mass of scar tissue in which cords and trunks are often indistinguishable There may be hard nodules in the nerves perhaps a root or roots cannot be found between the scalene muscles The fifth cervical or first dorsal may appear intact What shall be done? Incise? Excise? Anastomose — if so to what? Because I have tried to solve this problem so often I am convinced that complete brachial paralysis demands immediate exploration just as much as a perforating wound of the belly If ruptures exist they should be repaired at once If the cords have only been stretched they may be incised bleeding stopped and further operation delayed until the extent of the damage can be determined

By comparison the results after musculospiral paralysis are very satisfactory The nerve has been freed from adhesions or bony callus in 11 cases with marked improvement in 9 failure in 1 1 not heard from There have been 14 sutures 6 have been successful In 1913 I transplanted four inches of a dog's sciatic between the ends of the nerve There has been no improvement In 2 cases the recent operation of bone plating has been the cause of trouble In 1 the plate was found screwed to the musculospiral groove obliterating the nerve for three inches In another at the patient's request the plate was removed at the end of three months from a perfectly united humerus Wrist drop followed this operation The longest case was one of re suture six years after an unsuccessful union result unknown probably failure One primary suture recovered in eleven months The usual time is a little more than a year

Of all the peripheral nerves the ulnar and median are most often divided owing to the frequency of lacerated wounds of the forearm and wrist There have been 48 cases of suture 12 or 25 per cent coming to the hospital for a primary operation The average interval was seven and one half months the longest five years A few of the primary sutures have been almost perfect as has one (three months old) secondary suture of the ulna in the arm three years after the operation The results of the majority were unsatisfactory though trophic disturbances have usually been prevented When we consider that the ulna in particular regulates the fine movements of the hand the importance of early proper treatment of these wounds becomes obvious I shall later consider the reasons for failure

There have been 4 cases of excision of the sciatic nerve 2 for tumor 1 without suture another sutured by the flap method with recurrence of growth and no return of function I have twice excised nerve bulbs following one and three years after division and suppuration In 1 end to end suture was performed with partial recovery in the other too recent for result 2 two and one half inch gap was surrounded by a cuff of fascia lata If division is below the nerve supply to the ham strings the only deformity is toe drop and with proper support for the ankle locomotion is surprisingly good I have performed 6 sutures of the external popliteal the first in 1905 In 1 after three years secondary suture, the motor result is perfect though sensibility is somewhat impaired In 2 cases the nerve was cut high in the thigh where it was quite distinct from the internal popliteal In the other cases the nerve was injured near the head of the fibula An anastomosis of the external popliteal to the internal last January is too recent for a result

There have been 7 cases of *Volkmann's paralysis* of the forearm due to too tight splints In one there was no nerve lesion Resection of both bones gave a perfect result In the others the ulnar or median or both were strangulated by scar tissue or partially destroyed

Neurolysis resection with fascia tubes

has been followed by partial restoration of function. The operations have shown conclusively that in the majority of these cases there are actually nerve as well as muscle and tendon lesions.

I have operated three times upon the posterior nerve roots for pain never with complete success. I feel sure that in addition to the division of the roots forming the brachial plexus that the fourth cervical and second dorsal should also be cut. It is impossible to consider the many interesting cases of miscellaneous nerve injuries but I wish to say a word about tourniquet paralysis. A rubber tube should never be used about the mid arm. Even if the arm is padded the nerve may be crushed against the bone. I have seen one case of complete paralysis of the ulnar median and musculospiral nerves following excision of the elbow. The result was a real flail joint for almost a year.

I wish briefly to summarize the reasons for poor results of nerve suture as indicated by a study of the literature and this series of cases.

1. Inadequate examination at the time of injury and failure to note conditions found i. e. wrist drop after fracture of the humerus or toe drop after injury to the knee. If the patient can abduct the fingers from the middle line the ulnar is intact as is the median if the thumb can be opposed to the base of the little finger not flexed into the palm. Simple tests for sensation deep sensibility pin prick cotton wool and compass tests and test for heat and cold require no special skill. Electrical examinations demand a neurologist.

2. Failure to examine for nerve lesions in lacerated wounds of the forearm and wrist and failure to realize that lack of such examination may mean a maimed hand for life.

3. Exploratory operations should be done oftener and earlier. If a traumatic nerve lesion persists and there is reaction of regeneration in the muscles or continuation of pain Nature should not be trusted to bring about recovery. A definite cause will almost always be found and the quicker this is remedied the better the prognosis.

4. Secondary nerve sutures are almost never completely successful. Past suppuration and extensive scar formation are of more importance than the interval between the injury and the operation. Motion may be restored one two perhaps three years after injury but sensation will never become normal.

5. At operation scar tissue whether outside the nerves or within the nerves or between nerve ends must be got rid of. We have been too conservative. A scar nodule often better felt than seen should be excised. The nerve bulb must be thoroughly removed even if end to end suture cannot on this account be performed. Inadequate removal has been the cause of failure in many sutures. By traction on the bulb the proximal segment can usually be stretched about an inch. The nerve must then be cut cleanly with a sharp knife.

6. Hetero transplants and any foreign body should be avoided. An excised sensory nerve or fascial tube forms the best scaffold for the growing fibers. A three inch gap can thus be filled. If the distance is longer nerve anastomosis is probably better. Flap operations are to be avoided and the distal end should be sewed to divided fibers of the proximal nerve. Sherren has found that a sound nerve can be cut through one third of its circumference without permanent damage. In end to end anastomosis the nerve should be gently grasped with fine toothed forceps and one or more transfixing sutures of fine silk or chromic catgut inserted through the center of the nerve and loosely tied. The circumferences should then be approximated by fine catgut stitches passed only through the perineurium. Finally there must be absolute asepsis and careful hemostasis no tension. After treatment is absolutely essential for complete recovery. At first there should be rest then massage and galvanism should be employed until voluntary motion returns.

If all of these indications are followed I believe that work on the peripheral nerves will prove one of the most interesting and satisfactory fields of surgery.

SURGERY OF THE PERIPHERAL NERVES<sup>1</sup>

By CHARLES H. FRAZIER, M.D., F.A.C.S., PHILADELPHIA

I HAVE listened with great interest to Dr. Porter's contribution. The opportunities he has had for observation are unusual; the results he has obtained are excellent; his discussion is most instructive and the topic he has chosen for your consideration most timely. The European War has revived our interest in the problems of dealing with injuries of the peripheral nerves and while numerous contributions have appeared in literature sufficient time has not yet elapsed for a general round up and conclusions at this time can only be surmised.

Many interesting observations have been made during the war did we but have time to discuss them: the peculiar individuality of nerves, the propensity of one to motor disturbance as the musculospiral of another to pain vasomotor and trophic disturbance as the median and of another to pain as the sciatic.

As Americans we may take pride in the confirmation by the European surgeons of those original observations made by Weir Mitchell during the Civil War more than half a century ago and recorded in that well known monograph as to the difference between neuralgia and causalgia. The latter term Mitchell coined for the excruciating pains felt chiefly in palms and finger tips and soles of feet (where the touch organs are most abundant) aggravated by heat, emotion and noise, lasting months only to disappear spontaneously benefited but rarely by operation.

But to turn now to some of the practical phases of the subject of peripheral nerve injuries, the really vital question as Dr. Porter has indicated is given in injured nerve *when* is operation indicated and *what* operation gives the best results. Dejerine tells us to operate in all cases presenting the syndrome of complete interruption without signs of regeneration. Auerbach says immediately after healing of wounds of exit and entrance and Kirschner in not less than six weeks.

With regard to the time of operation the experience with gunshot and shell wounds during the present war has proved that it is difficult, if not impossible, in many instances to determine by the most careful examination whether the injury be in the nature of a contusion or laceration. Hence the importance of assuming a conservative attitude by waiting a reasonable time for the resumption of function. If taken within a reasonable time after the injury that is about two months the results will be as good as after immediate suture. I recognize the necessity of longer postponement on account of infection as a matter of fact the results of primary suture are almost as good as those of secondary suture.

After the injured nerve is exposed how will you deal with it? Here we might delve into speculative theories involving those of nerve regeneration and restoration of nerve function but to no purpose. For practical purposes it matters not how the cervical sympathetic by union with the phrenic may cause contraction of the vocal cords or the cervical sympathetic through the phrenic contraction of the diaphragm how stimulation of the phrenic through fusion with the cervical sympathetic causes hyperthyroidism (Cannon) how the hypoglossal facial anastomosis restores the complicated movements of expression how the nerves of a flexor group may innervate an extensor group. In 1906 I carried out a series of animal experiments in which both anterior crural and sciatic nerves were divided and sutured to one another; the central stump of the sciatic sutured to the peripheral stump of the anterior crural and vice versa and I was amazed to see how soon function was restored despite the confusion to the central nervous system.

The whole question of the method or modus operandi of impulse transference after nerve anastomosis or implantation is one of more than academic interest but very difficult of solution because we know so little about

the real character and mode of conduction of nerve impulses under normal conditions. It scarcely seems plausible that coaptation of fiber bundle for fiber bundle is essential to a satisfactory nerve suture as Stoffel and several others advocate in a recent report on nerve injuries in the present war since this is practically always impossible and the results of nerve suture are often very good. Moreover experimental work has shown that the results of suture of two segments of the same nerve are practically the same whether the union be effected in as nearly the old position as possible or whether one end be partially rotated before suture (Kennedy). The results of nerve anastomosis and transplantation both in the lower animals and in man are still further proof that nerve impulses may be carried via new paths from the line of suture to its cutaneous or muscular termination. If as the mass of clinical and experimental evidence would seem to indicate transference of impulses with return of function is possible the centers for these impulses in the central nervous system must be capable of altering their functions so that they may stimulate contraction in the new groups of muscles. I firmly believe with Kennedy that the return of function after nerve anastomosis is not to be attributed to a simple re-education process but is probably due to an alteration in the centers under the influence of altered afferent impulses from the muscles the brain thus having the capacity quickly to adapt itself to such alteration. Re-education would take a considerable length of time and it has been proved that the return of co-ordinated movements after nerve crossing is no longer than after the suture of divided ends of the same nerve. If nerve centers are capable of thus altering their functions in accordance with the new afferent impulses it would then seem that both nerve suture and anastomosis have a firm physiological foundation. In both cases there is transference of impulses to new paths.

Once the injured nerve is exposed how shall we proceed? Shall we resect and suture? Shall we resect and implant? How shall we bridge the defect? If the continuity of the nerve be apparently intact there may

yet be loss of function when fibrous tissue has taken the place of nerve fiber and here inspection and faradic stimulation will be found helpful.

A rather novel suggestion in nerve surgery is that made by Hofmeister who by injecting the nerve with a novocaine solution identifies points of fibrous constrictions by the hourglass appearance of the nerve at the site of fibrous deposits. If there be any reason at all to believe that the continuity of impulses is not altogether destroyed better results will be obtained by releasing bands by dissecting away cicatrices by removing neuromatous enlargements in other words by neurolysis than by any method of suture or transplantation. The experience of Hrahimato in the Russo Japanese war is preponderantly in favor of neurolysis as against suture.

If called upon to resect we must choose between lateral implantation the use of the autotransplant and the fascial or venous tube. The extraordinary facility with which adjacent nerves will assume the function of the injured after lateral implantation of the proximal and distal segments of an injured nerve was brought to my attention many years ago when in a case of aggravated spasticity of the upper extremity I effected a complete transference of the flexor into the extensor innervation only to find that after function was resumed by nerve union the atetosis and spasticity returned with their original vigor. As between these three methods—lateral implantation the use of the autotransplant and tubulization—when the defect is not long tubulization with the fascial cuff is the method of choice using the technique Lewis employed so successfully in his experiments on nerve regeneration. But when the defect is more than two or three centimeters long better results will be obtained by lateral implantation. (Whether the intact nerve serves only as a bridge over which the new axons cylinders from the central and peripheral ends of divided nerves may pass or whether the peripheral portions physiologically unite with the intact nerve whose fibers transmit their impulses is a question which can only be decided by most careful histological exam-

inations in a large group of experimental anastomoses)

As to the minute details of nerve suture all the difficulties and pitfalls will be experienced in a course of apprenticeship in facio hypoglossal anastomosis or facio accessory anastomosis. Sharp dissection rigid hemostasis the finest silk for suture material are of basic importance. Shall we surround the site of suture with fat or fascia or vein? It may not be necessary but one or the other should be employed as a safeguard against the ingrowth of scar tissue—the great bugbear of nerve suture. We are told of the importance of accurate approximation bundle for bundle of a divided nerve but to my mind all classical and theoretical considerations point to this refinement in technique as non essential.

A discussion of peripheral nerve surgery at this date particularly in connection with the relief of paralysis would be incomplete without reference to the so called method of direct and muscular neurotization the most original contribution for many a day. Erlacher has shown that the function of a paralyzed muscle may be restored by suturing a healthy nerve directly into the muscle and should there be no healthy nerve at hand a flap of healthy muscle will suffice. The point of implantation into the muscle is not of vital importance since histological studies show that new motor end plates form very soon after implantation a principle applicable to paralysis of the anterior tibial muscle which may be innervated through the peroneus longus to paralysis of the biceps which may be innervated by a flap from the triceps and to the paralysis of the deltoid which may be supplied by an implant from the trapezius.

Speaking of the management of individual palsies I am reminded of some experiments carried out a few years ago in searching for a method of relieving deltoid palsy—the most frequent of the residual palsies of poliomyelitis a rather timely topic. On the theory that each muscle is innervated by bundles of nerve fibers which pursue their individuality unmixed in the parent nerve I determined to ascertain whether it would not be

possible to innervate the circumflex which supplies the deltoid with that portion of the musculospiral which supplies the triceps. Minute anatomical studies were made upon monkeys and human cadavers, both adult and infant and it was found that the fibers supplying the triceps could be separated intact up to the edge of the tendon of the teres major at which point they occupied about one third of the dorsal portion of the nerve. This was a favorable site for anastomosis as the circumflex nerve was in close proximity.

The end results on the monkey proved the operation to be entirely practical and wholly successful in that the deltoid completely paralyzed by section of the circumflex, resumed its function after the distal end was united to the graft from the musculospiral nerve.

I have not applied the operation to the human, but I believe the principle ought not to be lost sight of and is worthy of your consideration.

Another method of dealing with spasticity still in the experimental stage is the implantation of surplus nerve fibers from the spastic muscle into the weakened antagonistic muscle in other words the application of neurotization to spasticity (Erlacher) whereby we attempt to strengthen the antagonistic muscle by supplying it with an excess of impulse from a center which is over irritable. While I firmly believe this method of transferring impulses has its field in the relief of paralysis I am not in accord with its application for the relief of spasticity. In the latter we are dealing with a lesion at some point in the corticospinal pathway which has so injured the inhibitory fibers that they no longer efficiently control the sensory stimuli. Any procedure which does not interrupt the reflex arc at some point thereby diminishing the sum total of the impulses is unsound in principle and could not be followed by permanent results.

Dr Porter has included in his discussion the treatment of brachial plexus palsies. There is no doubt that in most instances operation is too long delayed and while this may account for many failures and is a painfully

long list of futile operations I am convinced that the failures are not to be attributed alone to delay or to technical errors. It is more than likely that in many cases the degenerative processes extend to and involve the cells in the cord and in some instances the permanency of the paralysis is explained by the

injury to the roots—anterior and posterior—within the dural sac. My attention was directed to the latter contingency by a case which came under my observation in 1910 a case upon which an exploratory laminectomy disclosed a rupture of both anterior and posterior roots.

## RESECTION OF THE THYROID<sup>1</sup>

By EUGENE H. POOL, M.D., New York.

Assistant Surgeon, New York Hospital.

**P**ARTIAL thyroidectomy is usually practiced consists in extirpation of one lobe and isthmus sometimes supplemented by resection of part of the second lobe. In the removal of the lobe the technique generally followed is an intra-capsular extirpation that is the lobe is shelled out of the surgical capsule which is a connective tissue envelop formed from the deep cervical fascia. It is universally recognized that extreme care must be exercised in the dissection at the posterior aspect of the lobe to avoid injury to the recurrent laryngeal nerve and to safeguard the parathyroid glands. To provide a greater degree of protection to these structures some surgeons have advocated leaving a layer of thyroid tissue in this region but this procedure results in more hemorrhage which in some cases is difficult to control moreover it prolongs the operation and leads to greater post-operative exudate.

In a former article we presented the results of some investigations which were made to determine whether the theoretical advantages of leaving a portion of the posterior part of the lobe that is the part in relation with the recurrent laryngeal nerve and the parathyroid bodies have sufficient anatomical basis to outweigh the practical disadvantages of the procedure. These studies based upon 25 dissections led to the following conclusions:

1. For the prevention of tetany the posterior part of one lateral lobe must always be left. But even when one lobe only is operated upon permanent safety is best insured by leaving *in situ* the posterior part of

Pool and Falk: Concerning the surgical anatomy of the thyroid gland. *Ann. Surg.* 1914, 58: 12.

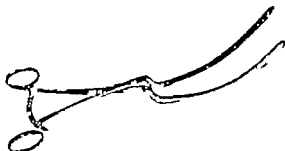


Fig. 1. Clamp for grasping thyroid prior to resection.

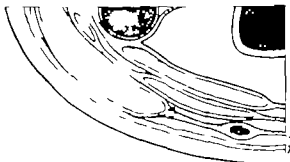


Fig. 2. The deep cervical fascia divides the anterior border of sternomastoid muscle into deep and superficial layers. T raises flap containing skin platysma and deep cervical fascia, the layer of the fascia which lies in relation with the deep surface of the sternomastoid muscle should be cut. A close to the division of the fascia into its two layers.



Fig 1 Photomicrograph showing relative positions of parathyroid recurrent laryngeal nerve oesophagus posterior part of lobe and capsule (Loom and Falk)

that lobe. Then if a subsequent operation with complete removal of the second lobe becomes necessary the operation may be performed with relative safety.

2 The recurrent nerve is relatively immune from injury when a true intracapsular extirpation of a lobe is made. Yet in attempting to carry out this procedure the capsule may be torn quite easily at its posterior part and the cellular plane which contains the recurrent nerve may be entered in the dissection and the nerve injured (Fig 3). This danger is avoided by leaving a portion of the posterior part of the lobe.

3 It is advantageous although not imperative to leave *in situ* the posterior parts of both lateral lobes in relation with each of which a recurrent laryngeal nerve and two parathyroids usually lie.

The amount of thyroid which must be left

in a thyroidectomy to avoid myxœdema is variously estimated as from one sixth to one fourth of the gland. On the basis of what has been said it would seem advantageous to secure this thyroid sufficiency by leaving the posterior parts of both lateral lobes resecting the anterior parts of both lobes together with the isthmus. Not only are the recurrent nerves and parathyroids thus safeguarded but as Balfour states "All sense of pressure is relieved and the neck is made quite symmetrical which cannot be said of some of the cases in which an entire lobe has been removed and the opposite lobe left untouched. After such an operation one can assure the patient that there will be much less liability of recurrence of the goiter than with any other type of operation."



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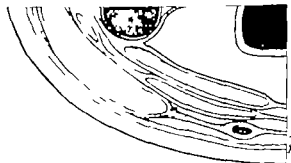


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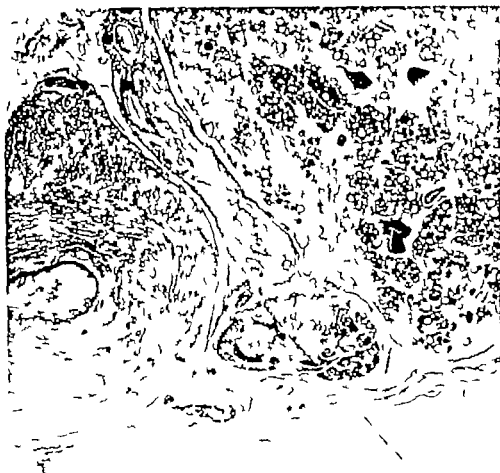


Fig. 3 Photomicrograph showing relative positions of parathyroid recurrent laryngeal nerve, capsule, posterior part of lobe and capsule (Pool and Falk)

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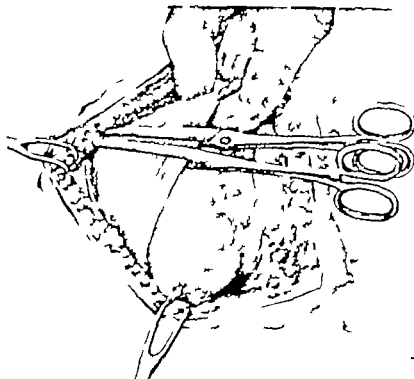


Fig. 4. Deep resection of the right lobe separated in a line. Clamp applied high on right group prior to the dissection.

The cases to which this operation is applicable are in general the diffuse colloid goiters. It is not necessary of course in the single cystic thyroid (or adenoma) where the trouble is due to an isolated tumor in the gland. It has a very limited field in the exophthalmic group where symmetry is a secondary consideration and the patient is operated on for relief of symptoms only.

In regard to the theoretical objections to resection it may be stated that hemorrhage can be controlled and rendered slight either by Balfour's technique or by the use of such a clamp as is described in this paper. The duration of the operation is not materially increased because in the resection it is not necessary that the lobe be stripped from within its capsule; therefore the operation is facilitated by substituting a resection for an intracapsular extirpation. Finally post-operative toxemia need not as a rule be considered since the method is rarely employed in toxic cases and then only in mild types.

Balfour describes the method of bilateral resection employed at the Mayo Clinic as follows: After freeing both lobes and planning what portions of each should be removed the isthmus is divided and freed from the trachea. A series of artery clamps are placed on the larger vessels in the capsule. These forceps serve the joint purpose of marking the part to be resected and of enabling one to control hemorrhage by traction on them along with support of the lobe from behind with the finger. The lobe is then encircled with an incision through the capsule just anterior to the forceps and the resection is then made by wedging out the anterior part of the gland. A continuous mattress suture of catgut is inserted behind the line of forceps. This controls bleeding and obliterates the cavity in the center of the lobe. The same suture returning in an opposite direction catches the edges of the capsule and rolls them together into some semblance to a normal lobe. The second lobe is treated in the same way.

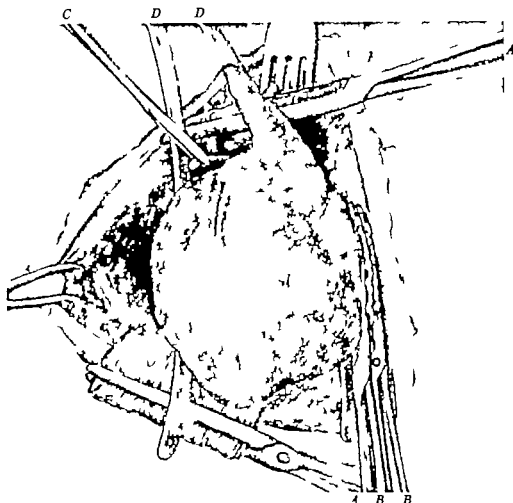


Fig. 5 Application of goiter clamp. Lobe exposed superior vessels sectioned pyramidal lobe freed isthmus cut across. *A* clamp on sectioned depressor muscles *B* *B* clamps on divided isthmus *C* clamp on superior thyroid artery *D* goiter clamp

The writer has found that in many cases the use of a clamp (Fig. 1) similar to a Scudder gastric clamp facilitates the technique of resection by lifting and steadying the lobe and controlling hemorrhage. The lobe is freed with or without ligation and section of the superior vessels as the case demands; the isthmus is cut across and its stump separated from the trachea; the lobe is then grasped well back by the clamp which is placed vertically with one blade on each side of the lobe. The clamp has long delicate blades so as to lightly grip but not crush the thyroid; it has a broad clutch by means of which it may be locked while the blades are comparatively far apart as in grasping a broad lobe; the bayonet shape allows the blades to be introduced more readily into the wound. It is advantageous to have several clamps of different sizes. The following outline of the technique of

bilateral resection is an elaboration of the description of an operation performed March 21, 1916; photographs were taken during the operation and from these the drawings were made.

*Bilateral resection for colloid goiter*<sup>1</sup> Patient in oblique position with head on higher plane than feet. Sand bag under shoulders so as to extend the neck. Goiter frame with apron in place. Intratracheal anesthesia with Janeway apparatus. Curved incision corresponding to natural crease of neck. Anterior jugular presented as one trunk, clamped, cut and ligated. Deep fascia cut through to the infrahyoid and sternomastoid muscles. Flap of skin platysma and deep fascia freed with knife and lifted as far as the incisura of the thyroid cartilage. The

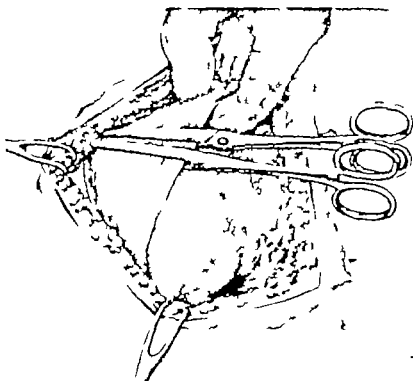


Fig. 4. Depressors of the thyroid separated in midline. Clamp applied high on left group prior to the dissection.

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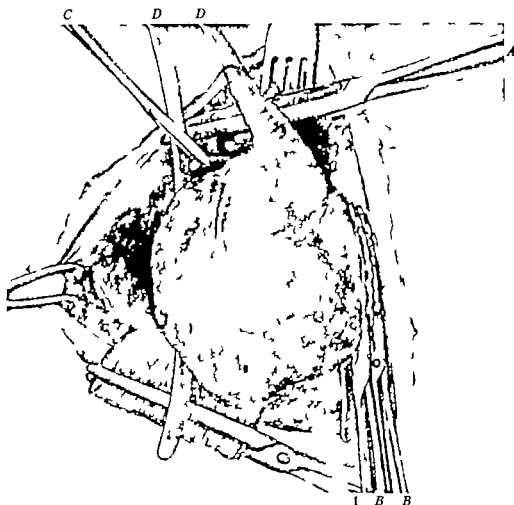


Fig. 5. Application of goiter clamp. Lobe exposed, superior vessels sectioned, pyramidal lobe freed, isthmus cut across. A, clamp on sectioned depressor muscles; B, B, clamps on divided isthmus; C, clamp on superior thyroid artery; D, goiter clamp.

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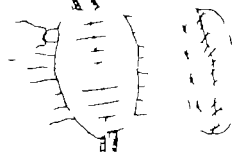
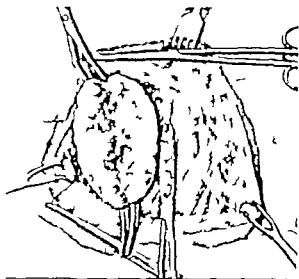


Fig. 1. Dissection of the neck before and after bilateral resection.

separation of a half flap including fat and anterior jugular vein is easy because of the natural cleavage plane between the muscles and the fascia. The feature to emphasize is that at the interior edge of the sternomastoid the division of the fascia is passed behind this muscle must be cut as the flap is lifted (Fig. 2). The depressors of the hyoid now lie well exposed. They are separated vertically with scissors passed between the sternohyoid muscles. In general retraction especially in large colloid goiters the sternohyoid, sternothyroid and omohyoid should be cut across and reflected on one or both sides. The line of division of the muscles should be high so as to avoid their nerve supply. Two straight clamps of the Pein variety without teeth but with longitudinal serrations are placed transversely across the muscles which



Fig. 3. Dissection of the neck before and after bilateral resection.

are to be severed (Fig. 4). The muscles are cut between the clamps which are left attached to the cut edges. This step may involve a confusing detail in that the sternothyroid is frequently extremely thin and since its medial margin is not visible it may be left undivided after the sternohyoid and omohyoid have been cut and the operator believing he has severed all these muscles may be confused by the appearance of muscle fibers overlying the capsule of the gland. With care all the muscles may be severed together. The handle of the lower clamp is slowly rotated and the muscles as a sheet are easily tripped free. The clamp is then allowed to hang over the outer edge of the wound. If the sternothyroid has not been divided together with the other muscles it should be clamped cut and reflected independently. Otherwise this thin muscle layer interferes with the freeing of the lobe. The lobe with the large veins of the capsule now presents well exposed. By pushing the finger gently into the plane mesial to the carotid this tissue plane is opened up and the lobe is liberated from the surrounding tissues to a considerable extent. In the case under consideration the operation was continued as follows. The left index finger was introduced behind the upper pole rendering the superior vessels accessible. These were ligated high. A clamp was placed across the vessels at the upper pole and the vessels were cut across. The lobe was then lifted forward and medially and separated from the posterior tissues until the branches of the inferior thyroid artery were reached. The lobe was then allowed to drop back.

The pyramidal lobe was dissected free and two clamps were placed across the isthmus and the isthmus cut across between the clamps. The right portion of isthmus was freed from the trachea. The lobe together with pyramidal lobe and stump of isthmus was then lifted and the goiter clamp placed from above downward and closed so as to grasp gently the posterior part of the lobe anterior to the recurrent nerve and parathyroid glands (Fig 5). The lobe was thus steadied and sufficient pressure was exerted to control hemorrhage. The large vessels on the surface were clamped just behind the proposed line of resection and the anterior part of the lobe was excised by making two parallel incisions which converged in the center of the lobe near the plane of the goiter clamp (Fig 6). The superficial vessels grasped by the artery forceps were then ligated. The goiter clamp was loosened sufficiently to recognize and clamp bleeders which were ligated. The two sides of the lobe were then approximated with mattress sutures and the edges overhanded with a continuous catgut stitch (Fig 6 A and B). The goiter clamp was then removed. There was no bleeding. A small lobe was thus constructed without injury to the recurrent laryngeal nerve, the parathyroid glands or the inferior thyroid artery before its entrance into the gland.

The left side was treated in the same manner. Two small lateral lobes were thus substituted for the enlarged thyroid. About one inch below the middle of the skin incision a stab wound was made and a small rubber tube penetrated by a piece of rubber

tissue was introduced for drainage. The sand bag was then removed from beneath the shoulders so as to relax the muscles and the depressor muscles of the right side were approximated by a stitch which overhanded the two clamps grasping their cut edges. The clamps were removed and this stitch was drawn tight and tied. The muscles on the left were treated in a similar manner. Several interrupted catgut sutures were used to approximate the muscles in the midline. The deep fascia was closed with continuous chromic catgut and the skin with subcuticular chromic stitch.

A clamp to facilitate resection was first employed in a case of large diffuse bilateral colloid goiter illustrated in Fig 7, operated upon at the French Hospital in November 1908. Both lobes were resected. The case demonstrated the feasibility of cutting across a lobe at will and of leaving the posterior part of a lobe with its blood supply, thus ensuring a sufficiency of parathyroids with their blood supply and not endangering the recurrent nerve.

#### SUMMARY

1. In large diffuse simple goiters double resection is the procedure which most closely meets all indications. It relieves pressure, minimizes danger to parathyroids and recurrent laryngeal nerve, provides a sufficiency of thyroid tissue and ensures symmetry.

2. Double resection may be carried out readily with little hemorrhage either by Balfour's method or by the use of a clamp as described or by a combination of the two methods.





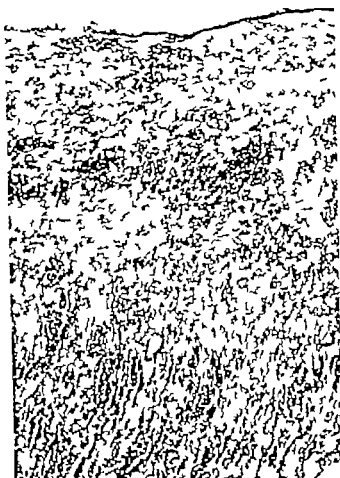


Fig 3 Case 1. Edge of coagulation in the right broad ligament showing coagulated carcinoma below and the peritoneum and connective tissue above.



Fig 4 Case 2. Edge of coagulation in the left broad ligament showing the blue staining zone separating the coagulated tissue below from the normal tissue above.

menopause at 42 ten years before her admission. She had been married 21 years and had had two children both living and well. The labors were easy and the puerperia uneventful.

**Present illness.** Six months before her admission to the hospital there was a profuse vaginal discharge of clotted blood lasting several days which recurred once several weeks later. Otherwise there was no history of bleeding obtainable.

Three months before admission the patient noted rapid loss of weight, felt run down and had no appetite. Shortly afterward she began to have dragging pains in the lower abdomen which became progressively more severe but never excessive. Burning on micturition, constipation and painful defecation were the only other symptoms.

**General physical examination.** Was negative except for moderate tenderness to deep pressure over the lower abdomen. **Pelvic examination.** The vaginal outlet was moderately relaxed. The vaginal portion of the cervix was entirely destroyed by a rough firm growth. The lateral fornices were resistant and sensitive. The fundus was small and in anterior position. Its mobility was greatly restricted. **Rectal examination.** There was

a firm mass in each broad ligament that on the right was somewhat the larger and adherent to the pelvic wall.

The white blood count 10,240 hemoglobin 56 per cent (Sahli).

**Clinical diagnosis.** Carcinoma of the cervix inoperable.

**Operation.** The abdomen was opened in the mid line and the intestines packed off from the pelvis. There was a mass 3 x 6 centimeters in the right broad ligament continuous with the uterus and a hydro ureter on this side measuring 1.5 centimeters in diameter. A somewhat smaller mass occupied the left broad ligament. The right adnexa were atrophic but otherwise normal. The left tube was swollen and its fimbriated extremity closed and adherent to the sigmoid. The lumbar and iliac glands were not enlarged.

The left tube was removed. Both internal iliac arteries were ligated with silk. The peritoneum was closed over the ureter and vessels on each side of the pelvis and then both infundibulopelvic ligaments ligated.

Then the patient was placed in the perineal position and the vagina dilated manually until it readily admitted the water cooled speculum. A piece of tissue was removed for section. A Percy



The medulla has softened into a thick chocolate like fluid.

**Kidneys.** Right weighs 160 grams. The capsule strips readily leaving a smooth gray opaque surface. The striations are well seen and are regular. The glomeruli appear as glistening dots. The cortex measures 4 to 5 centimeters. The pyramids are dark red.

Left kidney weighs 145 grams and is similar to the right. **Pelvic organs** are removed in one mass. The rectum and sigmoid show no gross abnormalities. No anatomical obstruction can be found. They are removed readily from the remaining pelvic organs. Externally the uterus is normal in size and contour. The peritoneum over the bases of the broad ligaments is discolored a purplish red. The vesico-vaginal space is obliterated and the posterior wall of the bladder is closely adherent to the vagina. The ureters show nothing abnormal down to their entrance into the broad ligament.

The mucous membrane of the bladder is injected except in the trigone where there is a fistula measuring 2 x 3 centimeters opening into the vagina. The edges of the fistula are reddish black and necrotic in appearance. A probe passed through the proximal end of the left ureter emerges in the wall of the fistula, passed through the right ureter it ends in a necrotic mass about 3 centimeters from the wall of the bladder.

In the vagina the orifice of the fistula is similar to that described in the bladder. The cervix and the tissues directly surrounding it are destroyed. The tissues in the neighborhood are no longer recognizable. They have a foul odor a grayish white color and a putty like consistency. On section this necrotic mass ends abruptly about 1 centimeter from the necrotic surface. Beyond this a gritty material of cartilaginous consistency occurs here and there in the bases of the broad ligaments.

The **neck organs** aorta and brain show no abnormality. The **intestines** are intact with no anatomical obstruction.

In the microscopic examination of all the viscera the following abnormalities were noted.

**Lungs.** The alveoli contain a few red blood cells particularly noticeable in sections from the posterior portions.

**Stomach.** The gastric mucosa is well preserved. As an ulcer is approached the definition of the cells of the mucosa become obscured and the nuclei are unstained by hematoxylin. The ulcer consists of a loss of substance extending through the submucosa to the muscularis. At the inner edge of the muscularis there is a distinct line of polymorphonuclear cells across the base of the ulcer (Fig. 1). A large blood vessel in the immediate neighborhood of the ulcer is intact. **Liver.** In the central part of the lobule the cells show fatty change. Elsewhere they have undergone extreme swelling and disintegration. **Adrenals.** Cortex is apparently normal. In the medulla there is a general disintegration of the tissue. **Kidneys.** The general structure is

normal. There is extensive epithelial necrosis in the convoluted tubules. **Lymph glands.** The lymph glands are normal. They do not show necrosis or metastases.

**Pelvic organs.** Sections from both broad ligaments and from the posterior wall of the vaginal vault at the level of the cervix show perfectly preserved squamous cell carcinoma. Sections from the necrotic areas stain a uniform bluish pink and carcinoma tissue can be distinguished only by its outline. All gradations can be seen between this necrotic area and the surrounding well preserved tissue (Fig. 3). In these intermediate areas many of the nuclei of the cells are unstained and show karyolysis or karyorrhexis. Other cells intermingled in these areas have bright pink staining cytoplasm and a sharp well stained nucleus. In many cases mitoses are seen. The changes observed in the connective tissue and smooth muscle of the pelvis are analogous to those in the neoplastic tissue. The nuclei become obscured and broken up and the tissue stains uniformly bluish pink. The vessels are all thrombosed. Masses of polymorphonuclear cells occur throughout the tissues as well as large blue staining amorphous masses of bacteria. There are several areas where carcinoma cells are invading normal tissue. In these there is nothing to indicate any difference in susceptibility between the carcinoma and normal tissue. The cytological changes are in every instance equidistant from the necrotic edge. In making blocks care was taken to cut them in a plane radial to the necrotic edge to make the observations certain. In a block taken posteriorly from the cervical region the zone of cytological change had a maximum width of 6 millimeters (Fig. 2).

**Anatomical diagnosis.** Primary carcinoma of the cervix of the uterus (operation, laparotomy and cauterization) vesicovaginal fistula intestinal distention thrombosis of pelvic veins hydrothorax (bilateral) multiple gastric ulcers, epithelial necrosis of kidneys cloudy swelling of viscera. **Secondary** chronic mitral endocarditis fatty liver encapsulated caseous tuberculous bronchial lymphadenitis.

The pathological changes in this case pulmonary oedema, haemorrhagic serous effusions extreme cloudy swelling of the viscera, renal epithelial necrosis and gastric ulcers correspond to the findings in extensive superficial burns. It is therefore possible that death may in part, be due to the same unknown factors. On the other hand the pulmonary embolism was important.

**CASE 2. Clinical history.** I. P. a white woman age 55 years was admitted to the hospital for the first time in October, 1915 complaining of a bloody vaginal discharge. **Family history** was unimportant. **Present history.** After a normal menstrual life the

menopause set in at the age of 45 1/2 years before her admission. She had been married 4 years and had had nine children. The labors and puerperia were uneventful.

**Present illness** Three months before diagnosis she began to have a persistent bloody vaginal discharge and two months later two profuse hemorrhages. She had lost 30 pounds during this period.

General physical examination was negative. P11 examination. The perineum was moderately relaxed. On the posterior lip of the cervix there as a small friable granulae are not more than 2 centimeters in its greatest diameter.

The lateral fornices were soft and there were no pelvic masses. No tenderness was made out.

**Clinical diagnosis** Carcinoma of the cervix early

**Operations** The uterus was removed with a wide margin of parametrium on both sides (Wertheim)

**Pathological report.** Squamous cell carcinoma of the cervix. The involution was uneventful save for cystitis which developed after repeated catheterization.

She has a recent history of four months after leaving the hospital the patient had pain in the lower left abdominal quadrant and frequent painful micturition. One month later there was a slight blood tinged vaginal discharge. This had continued four days when she was readmitted to the hospital April 26, 1960. She had lost ten pounds during the hospital stay. General physical examination

There was marked tenderness to moderate pressure over the left abdominal quadrant. Peristalsis. The left broad ligament contained firm sensitive mass measuring about 5 centimeters in diameter which was firmly adherent to the pelvic wall.

**Clinical diagnosis:** Recurrent carcinoma left broad ligament

**Operation.** The abdomen was opened in the midline the scars of the previous operation being excised and the intestines packed off from the pelvis. There were no adhesions to the pelvic peritoneum being everywhere smooth. No node enlargement of the regional lymph glands could be determined by palpation. The ovarian vessels had been ligated at the previous operation. Both internal iliac arteries were now ligated with heavy silk and the slit in the peritoneum closed on each side of the pelvis. The incision was protected by a patient placed in the perineal position and the vagina dilated to admit the whole hand. A Perry catheter (Point E) was then introduced through the water-cooled speculum into the middle of the left broad ligament mass. The tip of the point came thirty centimeter of the serous surface. Heating was continued for two hours at a temperature just insufficient to char the tissue.

During the entire process a constant sizzling sound could be heard and occasionally a little oily fluid would run down from the heated area into the vagina. The broad ligament mass became adherent to the cautery point and on two or three occasions the surface temperature was raised to a point which could not be borne by the hand enclosed

medium, a high rubber glove. On these occasions the assistant twisted the point out of its bed, removed the shell of coagulated tissue and immediately re-introduced it.

At the conclusion of the operation the patient was in excellent condition. The pulse had varied from 60 to 80 throughout.

Part of rat rose. The pathogenesis of the disease for four days. On the fifth day urinary excretion developed. Her temperature had varied between the extremes of 99 and 102.5 when on the tenth day it rose to 103 and from then on remained irregularly elevated reaching a maximum of 100. Blood cultures on the twelfth and fourteenth day showed respectively 10 and 150 colonies of streptococcus per cubic centimeter. Death occurred on the sixteenth day.

*Autops* v No 4687 (six hours after death). The following points are noted. The body is that of a poorly nourished, hute, man 157 centimeters in length. A recent mud in scar in perfect condition runs from the umbilicus to the pubis. There are a few dilate fibrous adhesions in the pelvis and there is a little pocket posterior to the left broad ligament containing 3 to 4 cubic centimeters of green pus. The left plural cavity is normal. The right plural cavity contains 500 cubic centimeters of clear yellow fluid containing flecks of fibrin. A little fibrin can be seen on the surfaces. The pericardial cavity contains 50 cubic centimeters of cloudy yellow fluid. Smears show many polymorphonuclear leucocytes and long chains of streptococci. There are many extensive subserous echymoses in the pericardium.

Heart weighs 300 grams. It is normal. Lungs  
 are all right. Lymphatic congestion and a fibrous  
 scar at the apex. There is nothing noteworthy  
 in the spleen. Spleen weighs 60 grams. It is normal. Stomach  
 and duodenum are normal. Pancreas weighs 80  
 grams. It is normal. Liver weighs 67 grams.  
 Gallbladder is a slight cloudy swelling. It is normal.  
 Adrenals are normal. A duodenum. Right kidney  
 weighs 30 grams. Left kidney weighs 40 grams. They are normal.

*Pharynx* Are removed in one mass  
The rectum and sigmoid show no gross abnormality  
The remainder readily removed from the remaining organs. The peritoneum over the vaginal suture has closed perfectly following the first operation. It is injected and there is a slight fibrinous exudate. The vesicourethral space is bilaterally and the bladder is closely adherent to the vagina. The ureters are normal up to their entrance into the broad ligament. The uterine membrane of the bladder is injected. In the trigone there is a fistula less than

In the case the operator right hand rode at the abdomen grasped the broad l gusset mass the le hand scried the cu ary. At the circle on the eye cu an anal tract l p ed and perused closed the abdomen D the dt has advocated h med flex ion of the le ku que Am J Ob M Y 916 Jan p

1 centimeter in diameter which communicates with the vagina. The edges are black and necrotic. A probe passed down the right ureter emerges at the edge of the fistula. Passed down the left ureter it ends in a necrotic mass about 2 centimeters from the wall of the bladder.

In the vagina the edges of the fistula are much more discolored than in the bladder. The vaginal vault is intact but extending out into the base of the left broad ligament is a soft gray necrotic mass of tissue with a central opening representing the position of the coagulating point. Within 1 centimeter of this lumen the necrotic tissue ends abruptly in normal looking fat and connective tissue.

*Microscopically* the viscera show no particular change.

The pelvic tissues are very edematous and polymorphonuclear cells are prevalent everywhere. The smaller blood vessels are thrombosed. Extending from the area of necrosis there is a zone with a maximum width of not over 6 millimeters in any section where the tissue is uniformly pink staining except for blue amorphous masses of bacteria. The tissue structure in this area has entirely disappeared. Separating this zone of coagulation from the more remote tissue is a zone about 1 millimeter in width which stains a deep blue and under high power is seen to consist of granular nuclear material and polymorphonuclear cells (Fig. 4). Carcinoma cells can only be found in the left broad ligament near the bladder sinus. They are situated in clumps just beyond the zone of coagulation (Fig. 5).

*Anatomical diagnosis:* Primary—operation previous panhysterectomy for carcinoma of the cervix recent ineffectual Percy cauterization of recurrence in the left broad ligament streptococcus septicemia purulent pericarditis fibrinopurulent pleurisy (left). Subsidiary—pulmonary congestion Encapsulated apical pulmonary tuberculosis.

#### SUMMARY

The primary effect of the Percy cautery is to cause a necrotic mass extending more or less uniformly in all directions from the coagulating point.

A mass of sloughing coagulated tissue of this type offers an ideal medium for the growth of micro organisms. This is borne out by the sections of these two cases. It probably will be found impossible to prevent infection of this area and once infected the thrombosed vessels of the region may offer a ready entrance into the system. Therefore the danger of a septicemia is considerable.

We are convinced from our short experience with Dr. Percy's method that fatalities must have been frequent wherever this method has been used extensively and we

have been able to find only one complete report of a fatal case in the literature that of Dr. Boldt. This case is of particular interest to us because it agrees in all essential points with the findings in Case 2 and emphasizes the probable frequency of the development of a septicemia from the infected tissue at the coagulated area. In an article in *The Pennsylvania Medical Journal* (January 1916) Dr. Percy mentions four cases in which post mortem examination disclosed more or less of these lytic cells in a pulsatious mass free in the pelvis. In one case there was easily a pint of this material. The description of the clinical picture of these cases agrees fairly well with that of a fatal septicemia and it seems possible to suppose since blood cultures, microscopical examination or cultures of the mass were not reported that the four cases may have died of sepsis.

In Dr. Boldt's case and in the two cases reported above the Percy technique was applied most rigidly. Nevertheless microscopic sections show active uninjured carcinoma respectively four, eight and sixteen days afterward. In both of our cases it was found within one centimeter of the previous site of the heating iron.

#### CONCLUSIONS

1. The prolonged treatment of large carcinomatous masses by low heat may result in a rapidly fatal outcome with lesions similar to those in cases of fatal cutaneous burns.

2. The necrotic mass produced by the cautery forms a particularly favorable medium for bacterial growth. The organisms may spread to the surrounding tissues or reach the general circulation through the local thrombosed vessels. It seems probable that the greatest danger in the application of the Percy cautery is a local infection and a subsequent general sepsis.

3. Finally the technique is ineffectual in eradicating the carcinoma. There is no evidence from these two cases that carcinoma is more susceptible to heat than is normal tissue.

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## TECHNIQUE OF TRANSVESICAL PROSTATECTOMY

## DETAILS OF THE TWO STAGE OPERATION

B. PAUL M. PILCHER, M.D., F.A.C.S., BROOKLYN

**T**RANSVESICAL prostatectomy has been in use for many years with varying degrees of success. Its universal acceptance as the method of choice for prostatic enucleation has been delayed by several unpleasant and often dangerous features which have resulted from imperfect technique. Chief among these factors have been—

1. The discomfort to the patient due to continuous urinary leakage from the suprapubic wound.

2. The sloughing and infection of the wound.

3. Incomplete control of hemorrhage.

4. Confinement in bed.

5. Prolonged urinary leakage and a full wound.

6. Long continued urinary fistula.

The technique which has been developed for the elimination of the disagreeable features and the control of the dangers accompanying the operation have gradually shaped themselves into a logical sequence and a more or less definite method which results in a far greater degree of safety and comfort to the patient and in the great majority of cases has made the removal of the prostate a comparatively safe and easy operation.

The special features which recommend this method are

1. *Renal decompression with the least risk.* This is the first and most important requirement in these cases. It may be accomplished in one of two ways either by the repeated or continuous use of the catheter or by suprapubic cystostomy. In other words, by relieving the urinary stasis. We prefer suprapubic cystostomy performed under local anesthesia.

2. *Complete urinary drainage* by means of a suprapubic tube *without urinary leakage* and without injury or irritation of the urethra. The technique about to be described provides

a means of avoiding the constant urinary leakage which has prevented many surgeons from adopting the two stage operation. The bladder is completely drained or left partly full as the special features of the case may demand. The patient is allowed out of bed within 24 hours after the cystostomy.

3. *The securing of primary union of the cystostomy wound* thereby establishing an avenue of approach to the prostate protected by walls of granulation tissue and excluding the tissues and spaces most easily infected in opening an infected bladder. The prevesical and perivesical spaces are sealed up and are no longer features of the operation. This result is obtained in fully 95 per cent of the cases operated upon by this technique.

4. *Full recovery from the stage of depression* following renal decompression. This can be accurately measured not only by means of chemical tests but is judged as well by the ordinary standards of the clinician (See Chart).

The primary surgical indication has been met i.e. the relief of the urinary stasis and we can wait for weeks or even months if necessary before removing the prostate.

5. *Transvesical enucleation of the prostate* without reopening the prevesical and perivesical tissues. It allows a rapid enucleation of the prostate with the minimum of anasthesia.

6. *An absolute means of controlling the hemorrhage* following prostatectomy. The use of a specially constructed bag brings direct pressure to be it on the bleeding surfaces and effectively closes the vessels.

7. *Simple means of keeping the patient dry* using a button drainage tube (Figs. 24 and 25) providing complete urinary drainage without urinary leakage making superfluous all the cumbersome apparatus formerly used i.e. vacuum drainage attached to house water supply siphon drainage (Brennemann) Davbarn's drainage etc.

8 *Shortening the period of confinement in bed* Following both the first and second stage the patient is allowed out of bed within 24 to 48 hours after the operation

9 *Systematic education of the bladder to resume its function early*

#### TECHNIQUE OF THE FIRST STAGE

We perform a suprapubic cystostomy as a preliminary operation in every case of prostatic hypertrophy due to simple glandular hyperplasia, even when we have previously used an indwelling catheter. In cases where there exists an enormous dilatation of the bladder especially where this is accompanied by edema of the legs, scrotum or penis we practice gradual withdrawal of the urine through an indwelling catheter before performing the cystostomy. The main object of our first stage is to obtain a gradual diminution of the back urinary pressure which has disorganized the physiology of the kidney. In all other cases we proceed immediately to the suprapubic cystostomy.

*Suprapubic cystostomy* The operation is attempted under local anesthesia. The preparation consists of the usual catharsis given 48 hours previous to the time of the operation, no cathartics or enemata within 24 hours of the operation. Preparation of the field of operation by shaving and cleansing with soap and water the day before operation and the application of iodine when the patient is ready for operation. In emergency cases the area is shaved. Harrington's solution is applied followed by washing with alcohol.

Everything possible is done to compose the mind of the patient and inspire confidence in the operator. Examinations are carried out with utmost care and gentleness. As few as possible are made. At night the patient is given twenty to thirty grains of sodium bromide and this is repeated in the morning. In many cases we administer morphine sulphate  $\frac{1}{4}$  grain and atropin  $\frac{1}{16}$  grain half an hour before the operation. Eutropin and sodium benzoate may be given if desired but they are not necessary. Many urologists object to the use of morphine in these cases but the writer feels that each case is a law

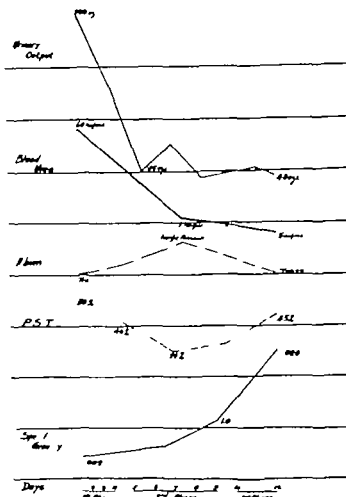


Chart of a patient treated at the Pilcher Clinic showing the reaction following first stage of operation. Showing the three phases of renal adjustment and gradual recovery from stage of depression. The amount passed in 24 hours dropped from 300 to 45 ounces. Gradual drop in blood urea from 60 to 5 milligrams. Marked change in albumin content drop and secondary recovery in the phthalein output. Very marked improvement in the specific gravity of urine. The convergence of all lines in comparing the condition on entrance to the clinic and at the end of third phase is quite apparent.

unto itself and the operator must judge the individual and not work by rule of thumb.

*The ideal technique*—a painless shockless operation. Clean cut division of the tissues. A good exposure of the anterior surface of the bladder with the least possible disturbance of the perivesical structures. Protection and reflection of the peritoneal fold. Fixation of the bladder wall before opening the same. Placing the opening and fixing the button drainage tube in the very summit of the bladder close to the peritoneum and as far away from the urethral opening as possible. Introducing the drainage tube with little if any soiling of the wound. Making a water tight



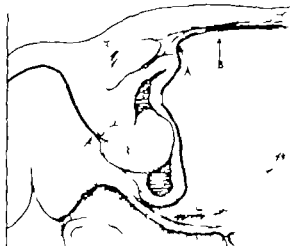


Fig. 3. Showing the surgical problem. Special attention should be directed to the fold of peritoneum in its relation to the symphysis. When the bladder is contracted (B) raising up of the peritoneal fold. When the bladder is dilated the relation of A and B to the symphysis quite variable and in some cases fixed almost to the symphysis.

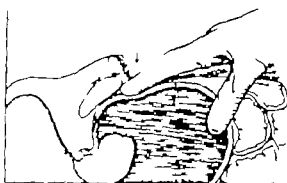


Fig. 4. First step is reflexion of the peritoneum. Index finger inserted around to under surface of symphysis then forced down and the anterior wall of the bladder and the peritoneal fold are reflected. The peritoneal reflexion will be complete.

bladder—drainage tube joint careful resuture of the wound closing all dead spaces careful application of the dressings supporting the wound. The detail must vary with the individual case. The shockless painless operation can be secured in the majority of cases by following out the principles of anococain association. Novocaine 1/5 of 1 per cent is used to infiltrate the skin and deeper tissues as well as the bladder wall. This in turn is fortified by the injection of 4 per cent quinine and urea hydrochloride into the muscles perivesicular tissues and next to the peritoneum.

The skin incision is begun one inch above the symphysis and continued in a vertical direction toward the umbilicus for about four inches. The fat and fascia are divided with a knife and the recti muscles are separated by the finger. The remaining fascia and prevesical tissues are easily separated. At this point the bladder is well filled with sterile water through a catheter introduced by way of the urethra after thoroughly cleansing the bladder. If it is not possible to introduce a catheter without undue force it is not attempted.

With the bladder full the finger is introduced into the wound until the under surface

of the symphysis pubis is reached then the finger covered with gauze is slowly swept upward gradually cleaning the tissues away from the anterior surface of the bladder at the same time forcing the peritoneal fold ahead of it. This is of great importance because the peritoneal fold frequently extends so low that it lies over the anterior wall of the bladder (Figs. 1, 2 and 3). After the bladder wall has been cleared it will be recognized by the tortuous dilated veins presenting on its surface extending somewhat in a fan shape upward. Also the appearance of the thickened muscle bundles forming the bladder wall is characteristic. When the finger is removed the peritoneal fold will be seen to sag downward. (Great care must be exercised in pushing back the peritoneum for it is easily torn. This accident has occurred to the writer but no untoward symptoms have followed the repair of this injury.)

When the bladder wall is properly bare retractors are introduced two lateral ones to hold back the muscles and one in the upper angle of the wound to hold back the peritoneal fold. When all is in readiness two retaining sutures are introduced into the bladder wall (Fig. 5) about an inch apart on either side of the point where the bladder is to be incised. This point is chosen at the uppermost limit of the bladder near the peritoneal fold (Fig. 4). Before the bladder is opened the fluid is allowed to flow out through the urethral catheter. The button drainage tube

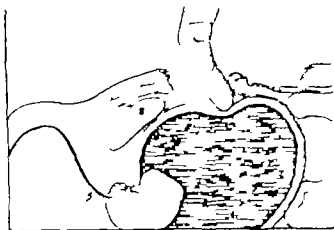


Fig. 3 Second step in freeing anterior wall of the bladder preparing same for high incision. Finger has been retracted back from symphysis along anterior face of the bladder carrying with it peritoneal fold P. If finger is removed from the wound at this point the peritoneal reflection will be seen forcing its way downward with each respiration of the patient.

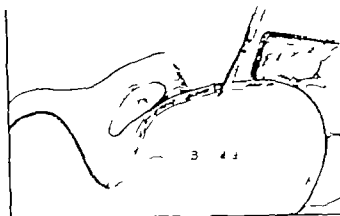


Fig. 4 Showing the position of incision into the bladder preferable at a point three inches from the urethral opening. The peritoneal fold has been reflected high up. The incision should be placed as high as possible.

is chosen (Figs. 24 and 25) and is held ready for use. Then the bladder is held up and steadied by the stays or clamps if preferred and an opening is made at the point chosen. The finger is inserted through the opening (Fig. 5) the interior of the bladder explored foreign bodies calculi etc. are removed and the character and size of the prostate is determined. When the finger is withdrawn the button drainage tube is immediately inserted and fixed in place either by a purse string suture of chromic gut or silk or by tying the stay sutures around the tube. If it is undesirable to empty the bladder the tube is plugged with a cork otherwise the tube is allowed to drain as it will. At times small vessels in the bladder wall are injured. These should be searched for and controlled.

**The drainage opening.** One should be perfectly satisfied with the position of the new opening in the bladder before completing this step of the operation. If after exploring the bladder the opening is found to be in the lower half of the bladder which would bring it too near the urethral opening it is better to re-introduce the finger in order to better outline the upper limits of the bladder (Fig. 7) and with this as a guide slowly dissect back the peritoneum and make a new opening (Fig. 8). Then the first opening is closed and the bladder is lowered.

we can almost positively assure ourselves of a rapid closure of the suprapubic wound provided that all of the obstructing prostate be removed.

Being satisfied with the fixation of the tube and its position and after testing it to see that it drains and runs free the prevesical space is next closed by catgut suture obliterating all dead space between the symphysis the fascia, and the bladder wall. Then the fascia and muscles are brought together below the tube (Fig. 10) by interrupted chromic gut sutures leaving the tube high up in the wound. The fascia and muscles protecting the peritoneum are likewise sutured with interrupted chromic gut sutures leaving only a little space not closed around the tube (Fig. 10). Then the skin is brought together by interrupted silk sutures (Fig. 10). The drainage tube should be further steadied by fixing it to the skin by means of an adhesive strip (Fig. 28). Then dry gauze dressings are applied and held in place by strips of adhesive tape.

The urethral catheter should be removed. If during the course of the operation the local anesthesia is not sufficient to deaden the pain of the operation a general anesthetic should be given. The writer never uses spinal anesthesia in these cases. Some operators however prefer it. The indications for its use are similar to those for other operations on the same subjects.

**The convalescent period.** Following the application of the dressings the patient is

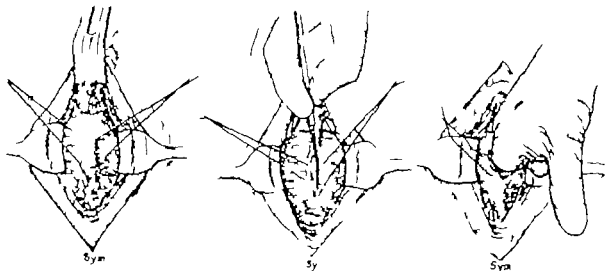


Fig. 5. Three steps in opening the bladder. (a) Retraction of the muscles introducing stay sutures to steady the bladder. (b) Plunging the knife to the bladder between stay sutures. (c) Immediately placing the finger

in the opening, keeping the wound dry by sponging externally the interior of bladder for foreign body and having a funnel or suction drainage tube ready for immediate insertion.

returned to his bed. *Management of the urinary drainage.* As soon as the patient reaches his room the aspirator is removed from the drain pipe and the bladder emptied. If there has been only a small amount of residual

urine continuous drainage is allowed. If there has been a marked and long standing distention the bladder continuous draining should be avoided the stoppered drain being opened at intervals of one to two hours as the case demands.

No attempt is made during the first three or four days following the operation to wash or medicate the bladder.

Whatever shock is going to take place from this encroachment on the urinary apparatus in cases of prostatic hypertrophy will become evident on the second to the fifth day after the suprapubic cystostomy. The patient is in the best possible condition to overcome this shock because there has been no loss of blood, no general anesthetic and no special pain, all of which factors tend to decrease the resisting powers of the organism.

*Results.* Primary union of the wound in practically every case.

An absolutely dry wound without any urinary leakage.

Complete control of urine for tests.

Half of the operation completed without anesthesia or surgical shock.

The elimination of the prevesical and perivesical spaces from the problem.

Makes unnecessary any further urethral instrumentation.

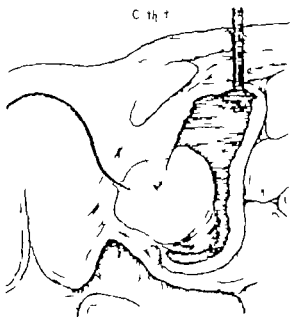


Fig. 6. The bottom drainage tube or catheter placed at this point in bladder the tissues planes sutured snugly about drainage tube entirely closing off prevesical and perivesical spaces. Experience shows that this drainage point here the bladder would be kept entirely empty without any syphon drainage.

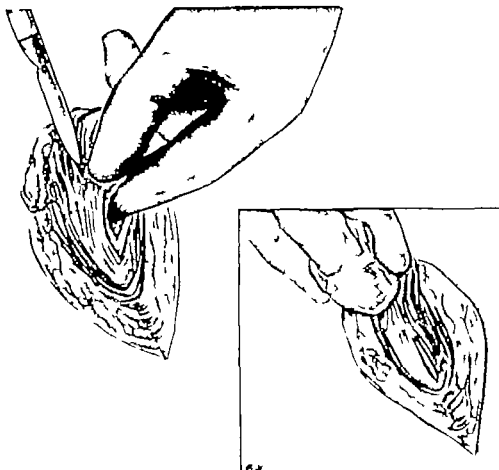


Fig. 7 Method of preparing a new site for drainage opening when one has found the first opening in the bladder too near urethral orifice. Finger in bladder locates peritoneal reflection and with knife and sponge the peritoneal attachments are gradually reflected from bladder and new site selected.

#### PROSTATIC ENUCLEATION

*Preparation for the second stage.* When the time for removing the prostate has arrived the patient is prepared for operation as before. All unnecessary catharsis etc. on the previous day is avoided. The patient is placed on the table and iodine is applied to the skin around the drainage tube.

*Anesthesia.* When all is ready the anesthetic is begun. At our clinic we prefer ether administered by the drop method.

In cases in which the period of depression following the renal decompression is short, i.e. from one to two weeks, it is not necessary to use any instruments to enlarge the drainage opening; the silk skin sutures are still in place and should remain (Fig. 11). Where the silk sutures have cut out it is sometimes wise to reinsert heavy silk stay sutures to splint the wound and keep it from tearing

open during the strenuous efforts often necessary for enucleating the prostate. Where a long interval is necessary between the first and second operation it is frequently of advantage to enlarge the opening.

*Enlarging the suprapubic opening.* This is done as shown in Fig. 11 by three radiating incisions extending on each side of and downward from the opening. These incisions are not necessarily more than an inch in length and are all carried down through the subcutaneous fat to the sheath of the rectus muscle.

*Making the approach to the prostate easier.* If the patient is very stout and the thickness of the abdominal wall leaves the prostate out of our reach it is indicated to remove sufficient of subcutaneous fat to allow the entire hand to pass as far as the sheath of the recti muscles. This reduces the intervening space

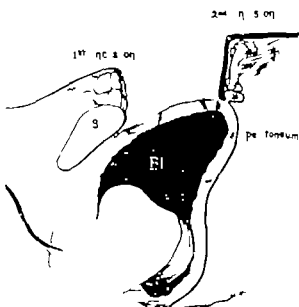


Fig. 8. Cross section showing first incision. The bladder placed to the side and point of incision on closed tubular prosthesis. The incision is made in the bladder wall. The bladder is empty. The incision is only an inch or two between the bladder incision and urethral orifice.

between the hand and the prostate very greatly and makes the finger distance about the same in all cases. In cases where the

approach is still too constricted to allow of complete control of the field of operation the wound is enlarged by carrying the two lateral incisions deeper through the sheath of the recti muscles. Thus any degree of exposure can be obtained without reopening the pre-vesical spaces. The incisions are not extended upward on account of the danger of injury to the peritoneum.

*The enucleation.* With the approach of the prostate provided for the enucleation of the enlarged portions of the gland is accomplished by entering the index finger of the one hand (or in difficult cases the index and second finger) into the vesical portion of the urethra slowly dilating it and seeking if possible the bandlike sphincter vesicae (Fig. 12). Having located this an effort is made first to separate the gland from the encircling sphincter by entering the natural line of cleavage which exists between the hyperplastic glandular masses and the muscular fibers (Fig. 13).

This is of advantage because if the internal sphincter is preserved the patient will gain control of his urine more quickly and the control will be more perfect and in the second place we find that where this muscle is preserved



Fig. 9. Incision closed by suture. Second incision a tubular incision through which button drainage tube inserted. First incision is carefully closed or by pericapsular sutures.

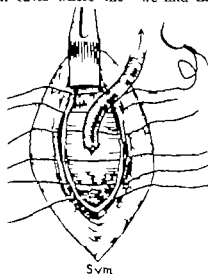


Fig. 10. Three steps in closing wound after laparotomy. (a) Left. The first suture, the last suture closing off the pre-capsular space and in (b) all of bladder the second and third sutures drawing together the rectus fasciae and the upper three sutures drawing together the fasciae below the peritoneal fold. (c) Further tightening of sutures and closing the wound tightly around catheter. (d) Suture of the skin thick. Closing wound around catheter about drainage. These wounds heal almost invariably without infection.



we seldom have any trouble from hemorrhage following the enucleation evidently because it causes a rapid contraction of the surrounding tissues. In the case of fibrous or muscular hyperplasia this separation of the sphincter is more difficult. In the cases with infiltration of the sphincter muscle and especially where a median bar has formed it may be indicated to remove a V shaped wedge which will include part of the internal sphincter. In any case *all prostatic tissue should be cleared from the sphincter muscle*.

Having accomplished this the finger is passed further along the urethra until the most distant part of the enlarged gland is reached. Here the lines of cleavage are sought and the enucleation accomplished slowly gently and completely<sup>1</sup> (Fig. 14).

The enucleation will be greatly facilitated by introducing the index finger of the unengaged hand into the rectum and lifting the prostate up. The finger should be protected by a rubber glove.

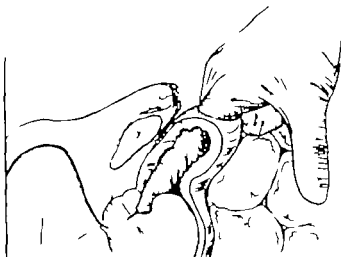


Fig. 12. In a great majority of cases without any enlarging of the wound the finger is passed through the suprapubic sinus and enucleation of the prostate is begun from within the urethra.

*Technique of prostatic enucleation* With the finger in the prostatic urethra the point of least resistance in the mucous membrane of the urethra is sought. Usually this will be found on the lateral or the anterolateral wall of the urethra. At this point the division between the prostate and the urethra is usually quite easily broken through. In most cases one is able to gain the line of cleavage through the urethra easily with the

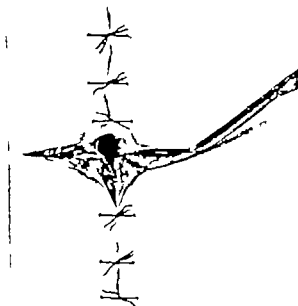


Fig. 11. Enlarging the suprapubic opening after cystostomy where a nearer approach to the prostate is desired. Note that there are two urethral incisions, and one toward the pubis extending down only through the fat layer. In doing an enucleation of the prostate the skin sutures remain in place to split the wound. The wound is not enlarged upward because of the danger of opening the peritoneal cavity.

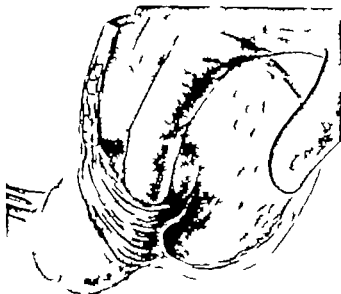


Fig. 13. After beginning enucleation of the urethral lobe the finger follows the sphincter muscles around the prostatic mass until the prostate is entirely free from it. If this is done before the prostate is removed the sphincter can be entirely freed from all prostatic tissue and there will consequently be less bleeding.

E



Fig. 4. After freeing the internal ph. the f. f. ed. d. al. the prot. t. retr. m. t. most distal. t. and here the al. least of the ph. l. begun. With one finger the re. tum. f. b. l. l. al. f. glo. d. l. ne. finger d. bl. k. t. l. ph. l. can be d. m. at t. el. ont. l. l. If l. t. b. one finger d. l. cult. t. l. l. found that l. n. m. t. l. l. on l. ung. r. en. leat. on. fa. l. ated.

gloved finger. The finger after entering the line of cleavage sweeps first slowly around the distal portion of the growth and then up over the anterior surface of the growth separating it from the encapsulating tissue. The finger is then passed across the urethra to the other side with a wringing motion of the finger and the opposite lateral lobe is freed. Then passing the finger up over the entire mass an attempt is made to turn the growth over so that it will easily turn out into the bladder carrying with it the median lobe. That is to say the finger is passed up over the two loosened lateral lobes and then beneath the same between the enlarged lobes and the rectum and then the finger is pulled toward the bladder so that the growth will turn upon itself.

As the growth is turned out into the bladder the bladder mucous membrane will be

stripped up from its posterior surface. The point which is most difficult to free is the attachment at the junction of the prostatic and membranous urethra which is seemingly a fibrous attachment or may be the attachment to the atrophied posterior lobe which lies distal to the ejaculatory ducts and which probably is not removed in the majority of cases. It has been our experience that those cases in which the prostate does not shell out easily should be carefully examined for evidence of malignancy.

A peculiar type of prostate which is occasionally encountered is the enormous prostate which seems to be hypertrophied in all its parts with the exception of the median lobe. Such a prostate is seen in Figure 15. In removing this prostate it may often be more completely and more easily done by

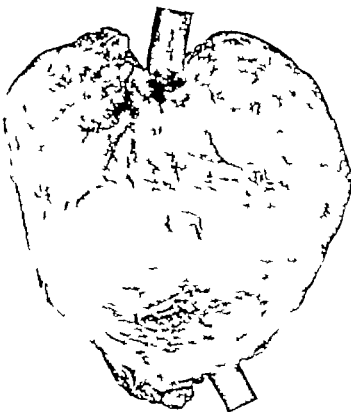


Fig. 15. Enormous bilateral enlargement of the prostate. Specimen removed in one piece.

passing the finger between the sphincter vesicae and the growth itself and sweeping the finger around the growth as recommended by Freyer. It will quickly fall out into the bladder. However in the majority of cases the intra urethral enucleation is to be preferred. It is quite essential for the welfare of the patient that all of the prostate as far as possible shall be removed. Thus Figure 16 shows a prostate with a very large median lobe and two moderately enlarged lateral lobes with many pieces of prostatic tissue which were dug out from the capsule after the main growth had been removed. The operator should never be satisfied with removing the larger hyperplastic masses alone but an attempt should be made to bring away all the prostatic tissue possible unless there is a diffuse carcinomatous involvement. If fragments remain they retard the healing of the cavity from which the prostate has been removed and are apt to necrose and cause a delay in the healing of the bladder.

It may be of great assistance to use the index and second finger together in freeing the glandular masses.



Fig. 16. Unequal enlargement of the prostate removed in sections together with crescent shaped stone. Upper part of picture shows small hyperplastic bits of tissue removed from capsule.

*Following the enucleation.* 1. Remove all foreign material from bladder i.e. blood clots, the enucleated prostate pieces of tissue and most important of all any small prostatic calculi which has been forced into the bladder during the enucleation. Frequently these calculi are overlooked and they enlarge and cause symptoms six months or so later.

A small gauze sponge is the best instrument to engage and remove the small calculi.



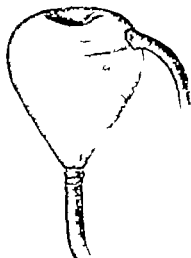
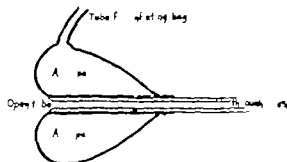


Fig. 7. The Picher hemostatic bag. The device is an inflatable rubber bag fastened about a large size catheter. Cross section in figure below shows structure of bag. The open tube catheter entered first through the suprapubic wound over a liver catheter and drawn down through the urethra. When the bag is in the bladder the tube in the urethra the bag inflated through the inflating tube and the inflated bag is used for pressure against the bleeding surface from which the prostatic mass removed. When pressure is desired the catheter attachment is pulled upon which brings the bag more tightly in contact with the bleeding surface. The pressure may be maintained by attaching the catheter tube to the leg. The catheter tube also acts as an incision for the escape of the urine from the bladder.

The principle of the bag hemostat was first suggested to the writer by Dr. Hagner of Washington.



Efforts should be made to control the hemorrhage: 1. By removing all the glandular masses or infiltrated tissue. This allows the cavity to contract just as does the pregnant uterus after being emptied.

2. By direct pressure one finger in the rectum and one in the bladder placing all torn bits of attached tissue over the lacerated area. Fresh muscle fibers will often seal the opening in a torn vessel.

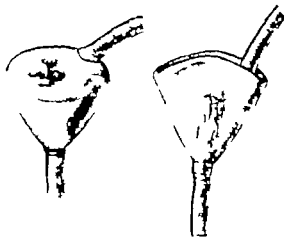


Fig. 8. The improved Picher bag hemostat with the protecting cal end of catheter attachment.

3. By the bag hemostat. We no longer use gauze packing to control hemorrhage in these cases on account of the uncertainty of its employment, the large amount of material necessary to secure absolute control of the bleeding, the unusual amount of sloughing of the bladder and wound following its use and the pain and unnecessary disturbance of the healing surface caused by its removal. We have adopted the suggestion of Hagner.

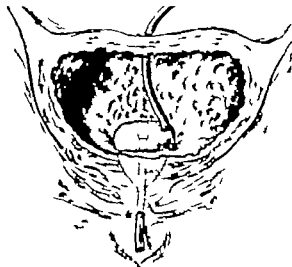


Fig. 9. Cross section showing position of bag hemostat in place. The inflating tube is inserted from superior surface of the bladder and catheter tube emerging from the urethra.

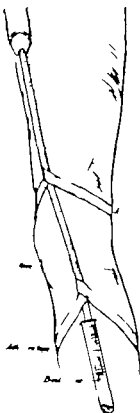


Fig. 20. Method of attaching catheter tube attachment of haemostatic bag to the leg by means of adhesive plaster to keep up intracanal pressure on the lacerated tissues. Note test tube over end of catheter to receive urine from the bladder.

of Washington which provides direct pressure on the bleeding surface by means of an inflatable rubber bag placed within the bladder the degree of pressure being controlled by

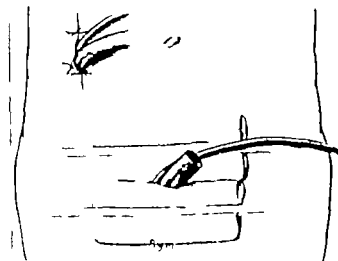


Fig. 23. Surface view of drain and dressing following suprapubic cystostomy in which bag haemostat has been used the smaller tube being the inflating tube of the haemostatic bag.

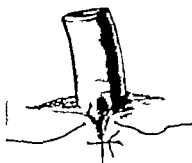


Fig. 21. Draining the bladder after enucleation. In every case of prostatic enucleation the bladder should be thoroughly drained. To do this a large calibre thick walled rubber tube large enough to allow the blood clots to escape if they accumulate should be introduced. This tube is held in place by a silk suture as in the figure. After the first few hours this tube is connected with a bottle and the bladder will keep itself empty and the patient dry.

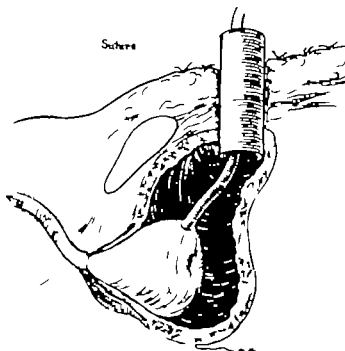


Fig. 22. Sketch showing complete drainage of bladder and haemostatic bag in place. After enucleation of the prostate inflating tube passing up through or beside large drainage tube. In two or three hours the bag is allowed to deflate and the pressure is relaxed. If bleeding recommences the bag is reinflated and pressure re-established. This bag is removed in twenty four hours.

a rubber tube which passes down through the urethra by means of which the bag is inflated and the bag held in contact with the lacerated surface (Fig. 17).

The writer has devised a bag haemostat of this type which embodies some new features

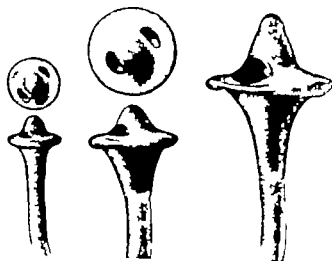
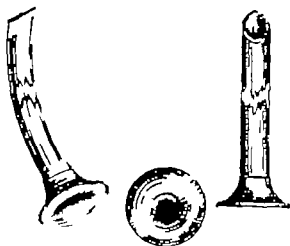


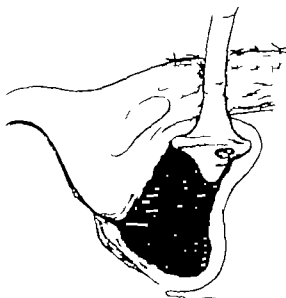
Fig. 24. Types of button drainage tubes made for the writer for use after the second stage of transvesical prostatectomy. Simply modified Pezzer catheters enlarged and reinforced to omit the special indications.



The object being to increase the comfort and safety of the patient. In addition our bag provides for the drainage of the urine through the urethral tube (Figs 18 and 19).

To place the bag a well curved silver catheter is passed through the urethra into the bladder after the prostate has been removed.

The open end of the urethral tube of the bag is threaded over the end of the silver catheter and attached there by means of a silk suture passed through the eye of the catheter. The silver catheter is then withdrawn in the natural way bringing with it the rubber tube attached to the bag. This tube is then secured the bag distended with air through the tube provided for that purpose and with one finger in the bladder the urethral tube is pulled upon drawing the bag down into the neck of the bladder from which the prostatic has been removed at the same time all tissue tags and torn muscle fibers are tucked in front of the bag and are brought in contact with the lacerated area. The urethral



The tube is attached to the leg by means of adhesive strips completely controlling the degree of pressure desired at the vesical neck (Fig. 20). By this means we have a static positive means of hemorrhage control which can be removed within an hour if desired and reapplied at will without disturbing the

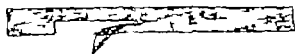
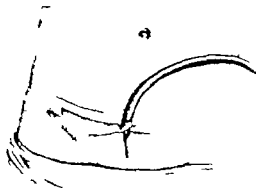


Fig. 7. Strip of adhesive plaster extended ten feet to drainage tube placed on the abdomen.

The tube is attached to the leg by means of adhesive strips completely controlling the degree of pressure desired at the vesical neck (Fig. 20). By this means we have a static positive means of hemorrhage control which can be removed within an hour if desired and reapplied at will without disturbing the

patient Its removal at the same time that the drainage tube is changed is accomplished with relatively little discomfort to the patient

*Drainage of the bladder* This we consider necessary in every case of transvesical prostatectomy A large size rubber tube is used preferably about an inch in diameter The tube extends only half an inch within the bladder and is fastened to the skin by a silk suture (Fig 21) If a hemostat bag has been used, the air tube is brought out through the drainage tube or beside it (Figs 22 and 23) A large size glass connecting tube is attached to the drainage tube and a second rubber tube is attached to it whereby the secretions from the bladder are collected in a bottle at the bedside In most cases this will be most satisfactory and the patient will be kept dry for the first 24 hours following the enucleation

*Management of the bag hemostat* With the bag inflated and in position Figure 22 we have an absolute control of the hemorrhage The amount of tension exerted on the urethral tube controls the degree of pressure exerted on the torn periprostatic tissues It is our practice to exert a considerable amount of pressure for the first hour after prostatectomy The technique of maintaining this is best shown in Figure 20 At the end of an hour all bleeding will have stopped The adhesive strips attaching the urethral tube to the leg are divided the bag is deflated and it remains in place but exerts no pressure The urethral tube in the meantime is functioning as a simple catheter and is draining the urine from the bladder into a bottle In other words we have provided a double exit for the urine and the result is added comfort to the patient a dry clean wound and a great reduction in the cost of dressings If any bleeding should start up again it is a simple matter to dilate the bag again with air and reapply the pressure The bag is removed in 24 to 48 hours

*First 24 hours after operation* If the patient is comfortable and dry and the draining tube is not causing pain or spasm of the bladder he is not disturbed in any way If desired he is allowed to sit up in a chair the day following operation

If the bag hemostat is causing trouble it

may be removed together with the supra pubic drainage tube at the end of 24 hours otherwise it is left in place for 48 hours

*Forty-eight hours after operation* The bag hemostat and drainage tube are removed at the end of 48 hours This is easily and quickly accomplished The distal end of the urethral tube is cleansed and covered with vaseline The suture holding the drainage tube is cut and the tube and bag are slowly and gently withdrawn from the supra pubic wound A long narrow retractor is immediately placed in the drainage tract to guide us in introducing the button drainage tube Depending upon the character of the wound we choose a specially made pezzet or Pilcher catheter or a button tube (Figs 24 and 25) Grasping the enlarged end of the tube with a pair of dressing forceps it is passed down along the groove of the narrow retractor until the end enters the bladder Then the forceps and retractor are withdrawn leaving the button end of the tube in the bladder In most cases the bladder wall will immediately contract and hold the tube in place In some cases this will take three or four hours When the tube is in place it is carefully tested by using a small amount of irrigation to make sure that it drains the bladder Frequently part of the irrigating fluid returns around the tube but in practically every case the greater amount returns through the tube, if it is properly placed When satisfied that the tube is properly placed it is fastened in place by an adhesive strip (Fig 27) and the tube attached to an extension tube and bottle In most cases this tube if correctly placed, will drain all of the urine from the bladder and after a period of a few hours will keep the patient perfectly dry Thus we consider an enormous advantage to the patient (Figs 26 27 28)

At the end of 24 hours some patients and after 48 hours most patients are allowed out of bed Common sense and not rules govern this phase of the subject

#### EDUCATION OF THE BLADDER

*One week after operation* By this time the healing at the neck of the bladder is well advanced and it is time to think of using the

urethra again. In one of our cases the suprapubic wound healed in four days. At the end of a week the button drainage tube is still in place and in most cases the patient is still dry. In some cases there will be some leakage along the side of the tube. When the patient is dry we encourage the use of the urethra by the patient. We temporarily close the drainage tube and allow the bladder to partially fill with urine. Then the patient is told to try to void *per urethram*. It is surprising to note how many will succeed. The majority begin by passing a dram or two each time every hour a little. At the end of 24 hours the patient will be passing an ounce or so every hour and gradually he is taught to resume his natural habit. All of this time we have the drainage tube as a safety valve. In a few days we find that most patients no longer need the tube and it is removed. Some suprapubic leakage will occur for a day or so but in many cases there will be very little after 24 hours. However this depends to a considerable extent on the care and exactness with which the first stage of the operation has been carried out. I refer especially to the placing of the opening in the bladder and the reconstruction of the wound. The suprapubic opening heals rapidly and as a rule is entirely free from the necrotic phosphate encrusted tissues which was previously encountered.

The technique above described is applicable in the majority of cases of prostatic hypertrophy and where followed out will give the

patient the maximum of security with the minimum amount of suffering.

The various steps of the scheme can be best seen in review by referring to the following tabulation.

### IMPORTANT PHASES IN A TWO STAGE TRANSVESICAL PROSTATECTOMY

#### TECHNIQUE EMPLOYED BY THE WRITER

*Re ad decompression:* Preferably by means of a suprapubic cystostomy using button drainage tube (Fig. 6). Local anesthesia.

*Drainage of bladder:* All urine collected through tube. No urinary leakage around tube. Patient dry. Out of bed.

*Sed peratio:* Transvesical finger enucleation of prostate. Ether anesthesia. One to ten minutes.

*First 48 hours after operation:* Patient dry. Urine drains through suprapubic tube and urethral tube is employed.

*Second or third day:* Primary suprapubic tube temporarily replaced by button drainage tube. Hemostatic bag removed. Patient at two to three hours.

*Third to sixth day:* All urine coming through button drainage tube. Patient dry. Out of bed.

#### EDUCATION OF BLADDER

*Seventh day:* Education of bladder begun with drainage tube temporarily closed during day. Urination *per urethram* is begun. Every hour at first. Patient dry.

*Eighth to tenth day:* Education of bladder continued. Gradual lengthening of interval between urination to three hours. Patient dry.

*Eleventh day:* Wound well cicatrized. Button drainage tube removed. Urination continues. Slight urinary leakage.

*Thirteenth to fourteenth day:* Sinus healed usually in three days.

## THE EVALUATION OF THE TRAUMA FACTOR IN HERNIA, MALIGNANCY, AND TUBERCULOSIS

By OLIVER J. FAY, M.D., F.A.C.S., Des Moines

THE apostles of medicine may be broadly divided into two groups: scientists and practitioners. The scientist deals with facts and with the working out of theories which are to establish facts. The practitioner, the man on the firing line, also deals with the world of things as they are, but its problems often take him beyond the realms of established scientific facts; he is called upon to answer questions for which science has as yet found no definite answers. He is not of choice an empiricist, but scientific investigation has not been able to keep pace with clinical needs, and he is forced to bridge the gap thus left with his clinical experience. Perhaps it is because industrial medicine is still a new field—I am speaking here of the science of industrial diseases and accidents and not of medical commercialism and fee splitting—that we are here confronted with the necessity of giving definite answers to so many unanswerable questions. It has been said that the only thing we actually *know* concerning the origin of cancer is that it is unknown; yet in the individual case the doctor is called upon to state definitely whether it is of traumatic origin. Hernia is of very frequent incidence, but the doctor must decide what few hernias are to be considered the result of industrial accidents. We do know the specific cause of tuberculosis, but we have come to look upon it as almost ubiquitous, and the doctor is expected to determine the part played by trauma in the development of any given lesion.

To the passing generation of physicians these questions were little more than interesting theories; to the physicians of today they have become of practical everyday importance. The development of social legislation rather than the development of medical science has been responsible for the change. Social legislation does not, it is true, belong to this century, nor even to the last. It

dates back as far as the Middle Ages, but until the latter half of the nineteenth century medicine had small concern with such legislation for it covered much the same field as do our charity and relief organizations of today. From the middle of the last century, even a decade or two earlier, industrial legislation began to concern itself with the organization and regulation of industrial insurance in part maintained by the workmen themselves in part by the employers and by government appropriation. The Emperor of Germany in his message to the Reichstag in 1881 first advocated the adequate protection from injury of the workman by the passage of compensation laws. Three years later such a law went into effect in Germany. In 1887 Austria passed a compensation law, Norway's first law providing for accident insurance dates from 1894, England's first real social legislation was enacted in 1897. Denmark, France, and Italy have had compensation laws since 1898, though in the two latter countries these laws are not universal in application. Hungary, Norway, Sweden, Belgium, Holland, Luxembourg, Switzerland, Spain, Finland, and Australia all have compensation laws, though some of them are inadequate. In our own country we have been slow in espousing the cause of the injured working man, though 33 of the states and territories have enacted some form of compensation laws; the majority of such laws have been very inadequate. Yet these state laws forecast a nation-wide movement, and with the development of social legislation there must come a corresponding development in practical medicine. Our fragmentary knowledge of trauma must be augmented; we must learn more of the role which trauma plays in the etiology of various diseases; we must learn to put an equitable value on permanent injuries; we must learn to make a prognosis in these cases which is based on something

more than a guess. For in the evolution of social legislation the time must inevitably come when all compensation cases will be taken out of the hands of an emotional and ignorant jury out of the jurisdiction of the politician and lawyer and be passed upon on their merits by the experienced physician.

His task will be no anecure. The questions which we are today called upon to answer require all our knowledge and judgment and all the assistance that can be gleaned from a study of clinical data. For discussion in this article I have chosen three of the most widely debated medico legal questions—in so far as this is possible I want to determine the value of the trauma factor in hernia malignancy and tuberculosis. Science has as yet given us no definite answer yet from the practitioner a definite answer is required. The experience of the individual is too limited to serve as a basis for its solution but the clinical experience of the many does afford the best criteria where science fails us and it is on the basis of clinical experience and clinical data that I shall attempt to find answers to these questions.

To the lay mind all or at least almost all hernias are of traumatic origin the common use of the word rupture to designate a hernia characterizes his view of the matter. And this view has been more or less shared by the medical profession. In an old Italian surgery published in 1671 by one Fabricio professor of surgery in the University of Padua the causes of hernia are said to be either internal or external and among the latter he mentions blows falls and the carrying of too heavy a load. With the recognition of the importance of a hernia anlage traumatic hernia fell into more or less disrepute and many doctors now maintain that a hernia is to be considered of traumatic origin only when it is the result of lacerating violence. Legally the term traumatic hernia has found a much more liberal interpretation in many instances any hernia developing while its bearer is at work has been held to be of traumatic origin. Even where the presence of enlarged inguinal rings could be demonstrated the

industrial accident was considered a contributory cause of the hernia and the workman accordingly entitled to compensation.

Too narrow an interpretation of the trauma factor in industrial cases works hardship and injustice to the individual workman. But the workingman has been quick to seize upon opportunities offered by the compensation laws and maintains sometimes from honest though mistaken conviction sometimes without this conviction that any hernia entitles him to compensation. Too loose an interpretation of what constitutes traumatic hernia works hardship and injustice not only to the individual employer and by increasing insurance rates to the employer as a class but indirectly to the workingman as a class as well. In Germany it has been found that many manufacturers in an attempt to protect themselves from this injustice refuse to employ any man with hernia or with a hernia anlage.

Recognizing the necessity for distinguishing between the hernia to which some industrial accident bears a causal relationship even though a subordinate one and the hernia to which it bears only a chance temporal relationship it is possible for the examining physician to distinguish between the two.

Berger has divided all hernias into three groups (1) hernia de violence (2) hernia de force (3) hernia de faiblesse. Though the French terms are more accurately expressive I shall employ the simple English equivalents or near equivalents (1) true traumatic hernia (2) industrial hernia (3) hernia disease.

In the first group the hernia is the direct result of violence resulting in the perforation of the abdominal wall or in suppuration of the hernia in either case protruding through the scar as in a postoperative hernia. The traumatic nature of such hernias is universally recognized their diagnosis is so obvious that I shall waste no time in discussing them if only because a true traumatic hernia is the white blackbird of the hernia family.

It is about the second group the industrial

hernias, that the battle royal wages and these hernias make up the bulk of the hernias to be considered under the compensation law. In this class of hernias, there is no external sign of violence to stamp them as of traumatic origin but a hernia is present and its bearer insists that it is the result of an accident a blow a fall, overlifting over straining slipping indirect violence of what ever nature. The greatest difficulty is encountered in determining whether any given hernia is an industrial hernia, or whether it is in reality due to hernia disease.

Under hernia disease, the third group we classify all those hernias which are the result of anatomical weakness whether the hernia is present at birth, develops gradually over a period of years or suddenly becomes manifest at some later period of life. The hernia anlage is present from birth the actual hernia may develop at any time.

The uncertain boundary which separates the second from the third group is manifest. Brandenburg who examined 3810 workmen employed in digging the St. Gotthard tunnel found that 381 per cent had hernia — men whose hernia interfered with the performance of heavy work would of course, not apply for such work — and that 80.2 per cent of the men had what he termed a predisposition to hernia i.e. the external ring admitted at least the tip of the index finger. Schwiening reported that of 1252795 men examined for military service in Germany the best of their men and in the strength of early manhood 197,416 or 15.75 per cent had hernias. Zollinger examined 4836 laborers he found that 2103 (43.4 per cent) had a slight tendency to hernia 1001 had a marked tendency to hernia (20.7 per cent) 228 had incomplete hernias (4.7 per cent) and 97 had fully developed hernias (2 per cent). While performing autopsies on 200 men, who during life had shown no signs of hernia Murray found that 68 (34 per cent) had so well defined a peritoneal bulging as to justify the term "sacculated hernia". Berger says that of 117 men who attributed their hernias to trauma, 96 (86 per cent) had other hernias of whose existence they were ignorant. It follows that the statement of

even the most honest of men cannot be accepted without question.

Of the cases of supposed traumatic hernia referred to the chief insurance referee from the lower insurance tribunals of Germany in 1905 only 2 per cent were declared to be in reality traumatic, in recent years a more liberal tendency has been observed and the percentage has gradually risen to 5.6 and 7 per cent. A large percentage of the entire number of cases are of course, settled without reference to this highest authority. Akerman whose position makes his words authoritative in regard to compensation in Sweden says that in 8 years he has had only 170 cases of traumatic hernia, and that after operation 40 of these were rejected. He considers this number exceedingly small since there are 700 000 men who come under the compensation law and 4 000 operations for hernia annually in Sweden. The bulk of what is written and said of traumatic hernia refers to inguinal hernia.

It is evident that the physician must have physical evidence to corroborate the statements of the patient, and those of his friends and fellow workmen. In what, then does this evidence consist? In France, in order that a hernia be adjudged traumatic, the national insurance bureau demands that

1. There shall have been a direct contusion of the inguinal region, or that the work being done shall have required more than usual exertion.

2. The injured man must have been forced to stop work immediately following the accident.

3. He must have been forced to seek medical attention at once or at most by the evening of the following day.

Brouardel who cites these regulations, says that the following points must also be given consideration

1. When a traumatic hernia first appears it is always of small volume. If the volume of a hernia exceeds that of an egg one may be sure that the hernia antedated the accident.

2. In a majority of cases a traumatic hernia is unilateral. A bilateral hernia or a unilateral hernia with a markedly enlarged ring on the other side is strongly suggestive of hernia disease.

3. If the inguinal canal is little more than an orifice the finger which is introduced into it enters the scrotum the inner wall of the canal is weak the idea of a traumatic origin may be rejected.



4 In traumatic hernia the inguinal ring is small hardly admitting the tip of the index finger the introduction of the finger causes pain

5 The presence of an ectopic testicle speaks strongly against the traumatic origin of hernia an ecchymosis is suggestive of such an origin

6 Marked obesity and emaciation alike weaken the abdominal wall and are to be considered as predisposing to hernia

According to Borchgrevink in Germany the injured man is required to show that

1 The injury received was of a character capable of producing a hernia

2 The hernia appeared suddenly as the immediate result of the accident

Injuries capable of producing hernia are defined as

1 Direct violence to the inguinal region

2 Slipping or falling while throwing or lifting some heavy object

3 Heavy though a customary work which was being performed under unusually unfavorable conditions

4 Extraordinary exertion

5 Extraordinary exertion from the standpoint of the age or strength of the workman

In order to prove that the hernia was the direct result of the accident it must be shown that

1 He complained of pain immediately following the accident

2 He was forced to give up work for a time at least immediately following the accident

3 The doctor was called not later than the evening of the following day

It is assumed that the forcing of an incipient hernia through the subcutaneous inguinal ring so that a complete hernia results is so serious a happening that a continuance of work is inconceivable and expressions of pain and the desire to consult a physician are to be considered necessary results

Inversely Kaufmann holds that the following circumstances prove or at least make it seem probable that the hernia is an old one

1 The previous demonstration of a hernia

2 Signs that a truss has been previously worn

3 The size of the hernia exceeds that of a lemon

4 The hernia is irreducible though not strangulated

5 The inguinal canal is short and broad its course only slightly diagonal

As confirmatory though not positive evidence against a traumatic origin are to be considered

The presence of a hernia on the other side

2 An enlarged ring on the other side

3 An ectopic testicle in the region of the hernia

4 The fact that the claimant has done heavy work over a long period of years

5 The advanced age of the claimant

6 The claimant's admission that he has previously had difficulty in standing

Many physicians hold that a hernia cannot be considered of traumatic origin if a herniaanlage existed that in these cases the accident which immediately preceded the appearance of the hernia simply called attention to an already existing condition or at most was only incidental to its development—the final straw which broke the camel's back. The law has in most instances put a more liberal construction on what constitutes a traumatic hernia and it has been held that a workman is entitled to compensation if the accident is shown to have been the immediate cause of hernia since if it has not been for this accident the unlage might have remained simply an anlage throughout life. For practical purposes then any hernia is considered a traumatic hernia when it is proved that the injury was the immediate though not necessarily the sole cause of the hernia

The proviso that the injury to the inguinal region must have been due to direct violence or that the accident or overexertion to which the hernia is attributed shall have been of a character capable of producing a hernia needs no explanation. Since there might be much discussion of what constitutes accidents capable of producing hernia the more specific statements given are welcome aids direct violence slipping or falling while throwing a heavy weight extraordinary exertion whether extraordinary in an absolute sense or extraordinary from the standpoint of the physique or age of the individual or the conditions under which the work was being performed

In the main we must also admit that the

absence of pain and the ability to continue work are hardly compatible with the idea of a traumatic hernia. It must be borne in mind, however that there are wide variations in the individual susceptibility to pain and that a workman with steady nerves and a strong will might continue to work under conditions which would completely overcome a fellow workman, might postpone a visit to his physician some days unless the hernia should become strangulated.

An industrial hernia is undoubtedly always small when it first appears and to estimate its maximum size as that of an egg can hardly work an injustice. To me it seems less safe to say that in traumatic hernia the inguinal ring is always small barely admitting the tip of the index finger. Brandenburg considered any ring which admitted more than the tip of the index finger or the absence of a true inguinal canal a predisposition to hernia, but his report of such a predisposition in 80.2 per cent of the men he examined seems to disprove this idea. Any condition present in four fifths of the men cannot be considered abnormal and we are therefore forced to conclude that no hard and fast rule concerning the size of the inguinal ring can be made.

A recent hernia is tender and painful on manipulation and an ecchymosis is not infrequently present. Immediate strangulation is common and it is said that the majority of cases adjudged traumatic and granted compensation in Germany are cases in which the hernia was strangulated when it first appeared. Even the cases in which strangulation does not occur are difficult of reduction but when once reduced do not come down again.

Strangulation always calls for operation of course but indications for operation in industrial hernias are in general far broader than in private practice. Practically all of these hernias occur in men who are performing hard manual labor and the inconvenience and the danger of strangulation are accordingly increased. If the operation is undertaken early it affords the best opportunity for definitely determining the nature of the

hernia — traumatic hernia or hernia disease. Our law should be so modified that every probable industrial hernia would be entitled to operation and a reasonable time allowance for recuperation — and in a great majority of these cases, this should be the only compensation allowed.

In a recent traumatic hernia the hernial sac is smooth and thin and is not adherent to cord or ring or at most such adhesions are of patently recent formation. There may be evidence of recent hemorrhage and laceration. An adherent sac a large inguinal ring with broad margins, a short broad inguinal canal a patent tunica vaginalis a thickened sac a large hernia or one that comes down and returns with the simple changing of position all these characterize the old hernia.

#### MALIGNANCY

In any discussion of the cancer problem one is met by the difficulty of having to deal with unknown quantities only — each and every premise must be represented by an  $\lambda$ . It has never been possible to produce tumors experimentally with anything approaching convincing certainty and until we do succeed in controlling our conclusions experimentally we shall have to continue to speak in terms of probabilities and possibilities in discussing the relation of trauma to cancer.

We do know that the bruising of tissues may cause the tearing of blood vessels hemorrhage disturbances in metabolism, and the death of certain cell elements but we have absolutely no reason to believe that such contusions can cause true tumor formation. We do know that the great majority of tumors develop without any demonstrable preceding trauma and that the countless accidents of our modern life with its added industrial and traffic hazards are followed by tumor formation in only a very small percentage of cases. We must, then conclude that trauma can never be the direct cause of tumor formation but only the indirect cause by calling forth hyperæmia inflammatory reparative processes a changed environment for the cell.

I shall not enter into any discussion of the different theories of the etiology of cancer

so long as the great pathologists of our day are still unagreed surely a surgeon may be pardoned for not rushing in where they fear to tread. Whether we accept Virchow's theory of external stimuli or Cohnheim's theory of embryonal rests or Ribbert's theory of postembryonal displacement matters little. We know that tumors may develop following a trauma but that they do not necessarily do so that trauma can never be the only and last cause of tumor formation. In order that trauma may give rise to a new growth specially predisposed tissue must be traumatized. Science has given us some idea of the nature of this special predisposition in some cases an error in embryonal development seems very probable an embryonal rest which has reacted to the stimulus of trauma in other cases a relationship between trauma and inflammation inflammation and tumor formation seems apparent and finally there are the less mysterious cases in which the trauma has acted upon an area which was macroscopically abnormal as for instance nevi and warts. The predisposing factor may be either local or general but the predisposition must exist before trauma can give rise to tumor formation of this we are fairly certain but from here on we must depend upon clinical evidence dispensing with scientific fact.

And even much of the clinical evidence is of uncertain quality for in a majority of the earlier reported cases of tumor following trauma the patient's account of the injury often dating back many years was the only evidence required the nature and site of the injury were recorded only in the haziest of terms. Loewenthal for instance did a monumental work in compiling statistics covering 800 cases of tumor formation following trauma but so many cases were included in which the causal relationship of trauma was so manifestly open to question that his percentage conclusions are of little real worth. Then too practically all of the older statistics included chronic irritation or repeated injuries under the head of trauma and according to the present day industrial interpretation of this term this

is not permissible. Von Buenger urged a standardizing of the statistics on trauma and tumor and with this object in view recommended that the reports from various clinics cover a five year period and deal specifically with two points:

The entire number of tumors coming under observation during a given five year period including a statement of the type and localization of each tumor.

2. An accurate statement of the number of cases in which the tumor could be attributed with certainty or with a probability bordering on certainty to a single severe trauma. The character of the trauma should be accurately stated.

There were several responses to von Buenger's request many of the largest German clinics being represented and the effect of such standardization at once became apparent. In the earlier statistics or those not compiled in accordance with von Buenger's conditions we find the incidence of the trauma factor rated as high as 44.7 per cent (by Loewenthal). The later statistics answering von Buenger's requirements evidence the wide variations which we would expect where so much depends upon the individual judgment of what constitutes a relationship between trauma and tumor but these later percentages have this in common that they are far lower than the older ones had been. In 4.24 per cent of Machol's cases the patients held that their tumors were of traumatic origin he himself accepted this statement in only 2.06 per cent of the entire number of cases. Wolff gave a percentage of 14.3. Liebe of 10.8. Wuernz of 5. Seidener of 3.9 per cent in his carcinoma cases and of 14.19 per cent in his cases of sarcoma.

Any discussion of the value of the trauma factor leads naturally to a discussion of the conditions under which trauma is to be considered a probable, or even a possible cause of the tumor formation. Jordan asserts that a clinical observation is of value only when

1. The contusion has been observed by a physician and its exact location noted.

2. The location of the tumor exactly corresponds with the site of the injury.

3 The time between the receipt of the injury and the appearance of the tumor is in accord with the probable period of development of a tumor of this given type

4 It is proved that a tumor did not exist at this point at the time of the injury

To me it seems that these requirements are impossible of fulfillment Many contusions even those of a severe type are not seen by a physician and the testimony of fellow workmen as to the severity and site of the injury would seem to be all that could be reasonably required in certain cases Loewenstem says that there are cases in which the accident is given so little thought even by the patient himself that it is not reported yet at autopsy death having resulted from a tumor signs of injury such as remnants of an old hemorrhage are found about the new growth The third condition would also require a very free interpretation we know that following operation there may be a local recurrence in a few days or only after some years and this in tumors of the same type Is it too much to assume that there may be an equally wide difference in the rate of development before operation? that then as later a cancer may have been quiescent and its presence unsuspected for years?

Loewenstem has found a more practical working basis He requires the following proof of the traumatic origin of a tumor

1 Credible proof of the receipt of the injury to be brought by the claimant or to be shown by the investigations of the judges at the beginning or close of the malady which later manifests itself as cancer

2 The accident must have been of a nature which makes probable the injury of the part which later becomes affected with cancer though it need not have acted directly upon it

3 The accident the intermediate or premonitory symptoms of cancer and the cancer itself must bear a clear relationship to each other

4 The disease which is attributed to trauma must have developed subsequent to the injury and at a time which makes probable a causal relationship due consideration being given to the morbid anatomy and the clinical type

These conditions accord in a general way with those laid down by other medico-legal writers particularly by Thiem who however defines the nature of the trauma somewhat

more clearly He says that the injury must have been severe enough to cause immediately appreciable effects, both from an anatomical and a functional standpoint, giving rise to credible symptoms which may later subside He also makes more specific statements concerning the premonitory intermediate symptoms the bridging symptoms as he terms them, and the interval of time which may elapse between the injury and the first manifestation of the new growth He lays special emphasis on these bridging symptoms particularly in the case of neoplasms developing after the passage of some time The possibility of a causal relationship between an injury and a tumor developing after the passage of two or three years is very slight unless such symptoms have existed An exception is made in the case of gliomata of the brain which are known to be of very slow growth Though Thiem usually accepts two years as the time limit in cases of sarcoma, three years in cases of carcinoma he admits that the interval may be a much longer one if the existence of 'bridging symptoms' is very clearly shown As the minimal time limit he accepts not less than eight days in sarcomata not less than 3 or 4 weeks in carcinomata I believe that this is rather an error in favor of the claimant and that tumors appearing in so short a time have been stimulated to more rapid growth by the trauma rather than that they have been caused by it Certainly we need have no fear of working an injustice to the patient when we accept his standards

#### TUBERCULOSIS

In considering the part played by trauma in the etiology of tuberculosis we are treading upon more certain scientific ground We know at least that tuberculosis is due to a specific organism and from this we know that trauma can at most be only a contributory cause it cannot produce tuberculosis at most it may determine its localization In how far then and under what conditions is this possible?

Thiem says that, in considering trauma and tuberculosis there are four distinct possibilities to be taken into account

1. A tuberculous infection in a person not previously tuberculous

2. The manifestation of a tuberculosis which was already present but which up to the time of the injury had remained latent

3. The tuberculous infection of the injured area from a tuberculous focus somewhere else in the body (*metastatic tuberculosis*)

4. The simple exacerbation of an old tuberculosis already manifest at the site of the injury

The greatest number of cases coming under the first head are those due to inoculation i. e. to the tuberculous infection of open wounds. The possibility of such infection has been proved experimentally as well as clinically and needs no discussion. Superficial wounds seem more liable to such infection than do the deeper wounds which bleed freely. Probably the great majority if indeed not all tuberculous ulcers of the skin even in people having other tuberculous foci in the body are due to such inoculation rather than to hematogenous infection. Penetrating wounds of the lung are sometimes followed by tuberculosis. Brouardel says that Demme lost 17 patients with tuberculosis of a total of 159 with penetrating wounds of the lung. The possibility of infection of the lungs in this manner cannot be denied but I believe that Demme's percentage of occurrence is extraordinarily high.

It would seem not improbable that tuberculosis of the lungs might have a similar origin following subcutaneous laceration or contusion of the parenchyma inoculation resulting from the inhalation of tubercle bacilli. Practically however traumatic tuberculosis of the lungs of this origin can at most form only an infinitesimal percentage of the entire number of cases of tuberculosis attributed to injury. Most of the cases supposed to have originated in this fashion fall under the second and the third head.

In the second group are classed those cases in which tuberculosis was present though latent at the time of injury and only was made manifest by it. If the injury was a severe one the shock and the lessened resistance due to it and to the resulting confinement to the house or the bed may activate the process. But in tuberculosis of the bones and joints particularly in children

there is still another class of cases which come under this head those cases in which the tuberculosis is the cause of the accident and not the accident the cause of the tuberculosis. The painless insidious onset of tuberculosis of the knee less frequently of the hip has escaped observation but it causes the fall which results in a minor injury to the affected joint. Attention is thus attracted to it and the tuberculosis is mistakenly supposed to be the result instead of the cause of the accident.

The third group is the one most readily controlled by experiment and repeated efforts have been made to determine tuberculosis in a given bone or joint by traumatizing it immediately before or after the introduction of tubercle bacilli into the blood stream. The results of these experiments have not been convincing. Krause and Schneller obtained positive results. Lannelongue and Achard, Honsell and Friedrich negative ones. The last two authors concluded from their experiments that the relationship between trauma and tuberculosis observed clinically in man was due solely to the lighting up of an old tuberculous process. It can of course never be proved that a tuberculous bone or joint was free from a latent infection prior to the receipt of the injury which gave rise to symptoms but from the practical and the legal standpoints it is sufficient to show that there had been no symptoms of such an infection prior to the receipt of the given injury.

On the 1703 cases of tuberculosis of the bones and joints which Honsell reported from the Tuebingen clinic 243 were of probable traumatic origin. In 88 of these cases the tuberculosis appeared as the direct result of the injury in 100 cases following the injury there was a period of improvement before symptoms of tuberculosis supervened. In the 54 remaining cases the patient had been free from symptoms for a time preceding the appearance of tuberculosis. Wiener from Mickulicz clinic reported a series of 436 cases of tuberculosis of the bones and joints of these 125 or 28.6 per cent, were attributed to a preceding trauma 26 cases or 6 per cent of the entire number gave a

typical picture of traumatic tuberculosis is the relationship between trauma and tuberculosis was a more or less direct one. In 54 cases, or 12.4 per cent, there was a short period of incubation between the time of the injury and the development of the first symptoms of tuberculosis. From the Bonn clinic 261 cases were reported and of these 23 or 10 per cent were attributed to trauma. Not all of these however bear the closest scrutiny. Thiem reported 405 cases in 123 or 30.3 per cent, of which a causal relationship with trauma was to be established. He states that such a relationship is evident in 20 per cent of all cases of localized tuberculosis.

In many of the cases of tuberculosis belonging to the third group trauma probably plays a dual rôle: the traumatized area is not only predisposed to infection by the increased blood supply and stasis but tubercle bacilli are liberated from old, dormant foci either through the mechanical insult or secondarily by inflammation.

Under the fourth head we may group those cases of tuberculosis which were manifest before the injury but which were exacerbated by it. These cases differ from those of the second group in one important particular: in the latter group the previous existence of tuberculosis was unknown. We may feel confident that it did exist, but we lack definite knowledge concerning it. In the fourth group we are dealing with a known quantity, if indeed, a physician may ever claim to deal with known quantities. The tuberculosis had been recognized, the stage of its development was approximately known. We thus have an established basis of comparison by which to judge of any post traumatic changes in the patient's condition.

In estimating the probable value of the trauma factor in any given case of tuberculosis the nature and severity of the injury are first to be considered as in other traumatic lesions. If the thorax is the part of the body injured in addition to the usual considerations of the force applied local subjective and objective symptoms and their duration special interest attaches to the presence of dyspnoea and hæmoptysis. Brouardel insists that in examining any patient

following an accident in which the thorax has been traumatized however slightly, the lungs should be carefully examined: exact notes made on any abnormal condition and the site of the trauma noted, though it is a mistake to suppose that a traumatic tuberculosis necessarily develops near the site of the injury.

The second point to be considered in passing upon these cases is the previous health of the individual. If we have to do with an advanced tuberculosis, there can be no doubt that it antedated the injury. But if before having manifested obvious symptoms of tuberculosis the claimant's health was poor, he had a chronic cough, frequent attacks of bronchitis or pleurisy, if he was often obliged to give up his work, we may also assume that the tuberculosis is not of recent origin. Inversely if he has been in apparently good health and has worked without interruption we must conclude that the tuberculosis, though not to be absolutely excluded, was at least latent, and that it would probably not have become active had it not been for the injury.

The time relationship between the trauma and the first evident symptoms of tuberculosis is also of importance. Marx in tabulating statistics from the Prussian war office reports 94 cases of tuberculosis following trauma and in a part of these cases exact notations of time are given. In 7 of these the bacilli were found in from 6 weeks to 3 months following the injury in 8 cases 3 to 11 months elapsed in another case the disease was clinically recognizable after 7 months although no bacilli were found. In a second group of cases, it is assumed that the tuberculosis was instrumental only in causing a flare up of an existing lesion. In 9 of the latter the tuberculosis became manifest between the sixth and the thirtieth days in 3 additional cases before the end of the third month. In a third group of 6 cases from 22 to 40 months had passed before the manifestation of tuberculosis and this interval was considered too long to permit of the establishment of a causal relationship. Kaufmann considers that such a relationship cannot be established after the passage of

more than a year Jordan thinks that it should not be more than a few months the German law gives a two year time limit to which Thiem subscribes, though he thinks that the presence of intermediate or bridging symptoms—pain stiffness or slight fever—may make an interval of many months or of years no evidence against a traumatic origin. The usual interim he places at 4 to 10 weeks. Where the tuberculous becomes manifest within 4 or 5 days the presence of a previous active infection is demonstrated for the tubercles do not begin to develop until 3 or 4 days after contamination and attain full development only after from 12 to 14 days.

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## SYPHILIS OF THE BLADDER

## REPORT OF A CASE AND A REVIEW OF THE LITERATURE

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THE purpose of this paper is to report a case of syphilis of the bladder and to review briefly the literature on the subject. Until quite recently vesical syphilis was considered to be very rare and some authorities even doubted or denied its existence. With the widely developed use of the cystoscope and the perfection of reliable laboratory tests our knowledge of diseases of the urinary apparatus has been wonderfully increased and it must be admitted as a result of recent investigations that syphilis will have to be given a more prominent place in the etiology of urinary disturbances.

Functional disturbances of the bladder associated with the so called parasyphilitic diseases of the central nervous system (tabes, paresis, etc.) are well known and are mentioned because they may be the first manifestations of these diseases and are usually readily recognized by cystoscopic examination. Also the invasion of the bladder by the direct extension of gummatous processes in the vagina, uterus and rectum are recognized and may produce what Neumann (1) has described as syphilitic paracystitis developing finally into an acute or chronic catarrhal cystitis and in some cases there may be a perforation of the bladder wall from without due to the breaking down of a gumma.

When it is so well known that the spirochæta of syphilis shows no discrimination in its attacks upon all the tissues and organs of the body it seems strange that so few cases of its direct action on the bladder have been described.

There is yet but little literature on the subject, most of which is German and French. In America only three cases have been reported: Morris, MacGowan and I. Simons.

Kelly and Burnam (2) in their recent treatise on the kidneys and bladder give the sub-

ject brief attention; they quote several cases reported in the recent literature, and describe the common symptoms and lesions as described by various authors.

Nitze (3) says that up to 1907 he had not seen a syphilitic process in the bladder. Frisch and Zuerkandl (4) in their *Handbuch der Urologie* 1904-1906 say nothing on the subject. Casper (5) merely mentions it. Desnos and Minet (6) writing in 1909 doubt the existence of luetic lesions of the bladder. Guyon (7) quoted by Lèvy Bing (8), says

the urinary apparatus may rightly be regarded as escaping syphilitic lesions though very exceptionally the kidneys may be directly affected. Legueu (9), writing in 1909 says that syphilis of the bladder is very rare. Fournier (10) in his work on syphilis in 1899 does not mention syphilis of the bladder, and Nogues (11) in the second edition in 1906 denies its existence.

Margoules (12) in 1902 reported three cases which he had observed and gave abstracts of thirteen other cases which he had collected from the literature up to that time. Of the thirteen cases seven were autopsy reports on bodies which showed other lesions of syphilis besides those found in the bladder. Morgagni (13) in 1767 a report of multiple ulcers of the vesical mucosa and tertiary lesions on the tongue and epiglottis. Follin (14) a report of twelve lentil sized vegetations of the vesical mucosa and destructive lesions of the palate and liver. Ricord (15) in 1851 a report of two cases showing extensive ulceration of the base of the bladder, one case having had a phagadæmic ulceration of the external genitals and the other case an acute suppurating process of the prostate and seminal vesicles. These two cases are disputed by Nogues, but Asch (24) thinks that the first case may have been one of a malignant form of syphilis. Virchow (16) in 1852 reported a case of disseminated tertiary le-



sions throughout the body (of an old woman) and the bladder very much contracted with extensive ulcerated vegetations scattered over the mucosa which was everywhere greatly swollen. Vidal de Cassis (17) observed a case of perforating ulcer of the bladder (gumma). Tarnowski (18) a case of superficial ulceration of the base of the bladder and posterior urethra in a four year old male child there was a very extensive secondary eruption over the entire body and mucous patches in the throat.

The remaining six cases were observed clinically the diagnosis having been based upon the accidental discovery or the later development of other syphilitic lesions. Cases of Grizow (19) who reported two. Morris (20) Chrzeltizer (21) Matzenauer (22) and MacGowan (23). The latter two were also observed cystoscopically. Matzenauer was the first to observe and describe syphilitic lesions of the bladder through the cystoscope his case a female presented a clapped out ulcer extending from the roof of the urethra to the base of the bladder and at the internal orifice were several polypoid vegetations from some of which filaments floated freely in the bladder. It is interesting to note that the cases of Chrzeltizer and MacGowan were treated for some time for cystitis prostaticitis and attacks of retention of urine before syphilis was suspected as the cause of the trouble. MacGowan found a circular group of small ulcers near the right ureter their edges thickened and from their ragged bases filaments of sphacelated tissue floated freely in the bladder. Both cases recovered promptly after mercurial treatment.

Margoules three cases complained of persistent hematuria and painful frequent micturition. Two were cystoscoped. In one was seen just external to the left ureter a group of three pea sized tumors surrounded by an area of light hyperemia. He made a diagnosis of carcinoma but as the patient refused operation and as she had had a seven months abortion some years previously he put her on mercurial treatment tentatively. To his surprise all symptoms rapidly disappeared and after three months only a faint scar remained where the tumors had been.

The second case had the most violent and unrelievable pains in the bladder and on examination a linear ulcer was seen just above the left ureter which disappeared completely after mercurial treatment. The third case was not cystoscoped until after recovery the patient was a tabetic and only a trabeculated bladder wall was to be seen hence this case cannot be considered as one of actual syphilis of the bladder though he recovered from the urinary distress.

The most recent studies of the subject are those of Asch (24) in 1911 and Levy Bing (8) in 1912 and 1913. Each of these authors has gone over the subject in the most thorough manner the publication of Asch being the most exhaustive study of the subject to be found in the literature. Asch has reviewed and critically analyzed all of the cases reported to that time and confirmed most of them as authentic. He reports three personal cases two of tertiary syphilis of the bladder and one showing secondary lesions. The tertiary cases had persistent hematuria and painful micturition. In one was seen just external to the left ureter a papillomatous tumor the size of a small nut behind and partly concealed by which was an ulcer about one centimeter in diameter with indurated margins and the base covered with a yellowish exudate. The second case presented a large gummatous ulcer at the base of the bladder. The third case showed twelve small superficial ulcerations scattered over a red and swollen mucosa resembling the secondary lesions seen on other mucous membranes. All three cases recovered promptly on mercurial treatment alone and the lesions disappeared.

Levy Bing reported one case of secondary syphilis of the bladder characterized by having no vesical symptoms but showing on cystoscopic examination a patch of moderate hyperemia just back of the trigone and on this were a number of small superficial ulcers. He observed this case through the routine cystoscopic examination of all cases in his clinic presenting a secondary eruption on the body. He states that in the secondary stage it is not uncommon to find areas of increased vascularity of the vesical mucosa though

there may be no urinary symptoms and he believes that secondary lesions will be found to be more common if there is more search made for them in this stage of the disease. They will not necessarily cause vesical symptoms.

In addition to the cases already cited Asch and Levv Bing collected thirteen other cases from the literature all of which were observed cystoscopically and recovered after mercurial treatment alone. A résumé of the cases follows.

Le Furs (25) case showed three ulcerations in the region of the trigone. This case was of special interest because of a large nodular infiltration in the right lobe of the prostate because it was treated for some months for cystitis and prostatitis and because the final diagnosis was made only after the development of mucous patches in the throat.

Graffes (26) case showed a deep ulceration of the bladder wall.

Englemann (27) had three cases. One showed a large ulcerating tumor near the right ureter the second showed a small partly ulcerated tumor in the same position which was at first thought to be a carcinoma and in the third which presented some marked signs of tabes there was a large elevated and incrustated ulcer on the lateral wall of the bladder. The lesions in all three cases disappeared completely after mercurial treatment.

Nin Posadas (28) reported a case of gummatous ulceration.

Picot (29) reported a case which had been treated for seven years for chronic cystitis in the region of both ureters were numerous superficial ulcers with pale bases and red margins placed upon a hyperemic patch of the mucosa the apex of the bladder was covered with discrete and confluent ulcerated tubercles. All tests were made for tubercle bacilli without result and the patient recovered with mercurial treatment alone.

Perschke (30) reported three cases of secondary lesions of the vesical mucosa all being characterized by multiple small ulcerations. In the first case the mucosa at the base of the bladder was swollen and hyperemic and in the vicinity of the left ureter were several ulcerations with elevated and infiltrated margins. In the second case there were seven small ulcers at the apex of the bladder. The third case showed a vesical mucosa greatly injected the vesical sphincter oedematous and scattered everywhere were ulcers of various sizes some with infiltrated margins and others with flat margins. All recovered rapidly with mercurial treatment alone.

E. Frank (31) at the Second German Urological Congress Berlin 1909 presented seventeen cystoscopic pictures of two cases of secondary syphilis of the bladder showing the lesions before during and after treatment.

Michialis (32) reported a case of secondary syphilis, the mucosa showing multiple small vesicular lesions surrounded by a rose colored zone, and on the anterior superior wall were many red spots resembling those seen on the skin in roseola.

In addition to the cases collected by these authors five others are to be found in the recent literature which brings the total of all cases so far reported to thirty eight, of which twenty five have been reported since 1902.

In 1911 Haberm (33) reported a case showing a large gummatous ulcer on the trigone, and a large tumor on the lateral wall near the vesical orifice the mucosa was everywhere smooth and glistening the Wassermann reaction was positive. Twenty days after one injection of salvarsan the ulcer had disappeared and the tumor was reduced to a very small size.

In July 1914 Givet and Favre (34) reported three cases. The first was an old man with marked tubercle symptoms. There was multiple ulceration of the mucosa which in the presence of tabes and an infected urine must be considered as a doubtful case of direct syphilis of the bladder. The second case a female showed the base of the bladder elevated as a projecting fold greatly resembling the projection of a median prostatic lobe. The mucosa here was deep red and in places showed small ulcerations. The third case a female showed a similar swelling at the base of the bladder close to the vesical orifice the mucosa over and surrounding the area being of a deep red color but there were no ulcerations. In all three cases the Wassermann reaction was positive and disappearance of the lesions followed antisyphilitic treatment.

I. Simons (35) in 1913 reported a case which was interesting because of the rapid development of the ulceration at the base of the bladder and the absence of any syphilitic history whatever.

The symptoms of syphilis of the bladder present no characteristic features which would at once arouse suspicions. The patient's attention may be attracted to the bladder because of the discomforts usually accompanying an ordinary cystitis or the first symptom may be a sudden hæmaturia which may be unaccompanied by any pain or discomfort whatever and may continue painless throughout the course of the disease. In the majority of cases there is painful frequent micturition accompanied at times with terminal hæmaturia of various degrees. In the tertiary stage hæmaturia is almost always present it may be marked from the first, or appear at intervals which become shorter as

the attacks increase until there is finally a total hæmaturia.

Levy Bing (8) says that the secondary lesions may occasion no symptoms whatever but usually the symptoms consist of increased frequency of micturition day and night alike and pain at the neck of the bladder referred to the end of the urethra the perineum genitals and to the abdomen. In the early stage the pain is relieved for a short time after the bladder is emptied but soon recurs and is usually very marked during the act of voiding.

One of the striking features of most of the cases reported was the extreme sensitiveness of the bladder to the solutions introduced for cystoscopic examination. In both the secondary and tertiary stages the pain is more marked the closer the lesion especially an ulcer is to the vesical orifice. In one case the pain at the neck of the bladder was so intense that no remedy would give relief. Urgency is another symptom which is always marked. Thus the symptoms are not much unlike those of renal and vesical tuberculosis.

The urine may show nothing except a few red blood cells and some pavement epithelium in the secondary stage or it may be more or less murky due chiefly to red blood cells mucous and epithelium with a relatively small proportion of pus cells.

In the tertiary stage the urine contains a larger amount of blood but unless there has been some secondary infection there is here also a relatively small amount of pus.

Bacteria are characteristically absent except in cases of secondary infection with the usual benign or pyogenic organisms.

There has been no case reported where the spirochæte was found in the urine.

The type of the lesion varies according to the stage of the disease. In the secondary stage one may see small macules resembling those of roseola or small multiple superficial ulcerations surrounded by a zone of light hyperæmia as seen on the other mucous membranes. The ulcers are the most common lesions and are always multiple as many as twelve or more being recorded. The surrounding mucosa is usually hyperæmic the vessels being tortuous and prominent.

In the tertiary stage the lesions are of two types the gummatous ulcer and the papillomatous tumor these two lesions may coexist. The ulcers are usually single with ragged infiltrated margins grayish bases and surrounded by a zone of deep red color. There is increased vascularity of the mucous membrane and the vessels are very tortuous and distended. In some cases, however the entire surface may be swollen smooth, and glistening and the vessels hidden.

The papillomatous tumors may be small or large smooth or very irregular and may resemble somewhat either carcinoma or the ordinary benign tumor. Their surfaces are frequently ulcerated and may be covered with incrustations.

The most common site for both the secondary and tertiary lesions is on the base of the bladder just external to the ureters but they may be found on any part of the bladder wall. In the male the gummatous tumor situated near the internal sphincter may suggest an intravesical projection of a lobe of the prostate. It is also common to find the vesical orifice in females greatly swollen and irregular or to find a gummatous tumor in this region. The tertiary lesions show no tendency to spontaneous cicatrization but tend to progress invading the bladder more and more deeply until perforation occurs.

Syphilis has been called the great imitator producing symptoms and lesions closely resembling those of many other diseases. However a diagnosis based upon the elimination of other common possibilities a strongly positive Wassermann reaction tested by a reliable pathologist and the disappearance of all symptoms and lesions with antisyphilitic treatment may be rightly accepted. Conclusions based upon these premises convince the author of the merit of the following case.

Miss F. age 39. On November 25 1908 came in complaining of pain in the bladder and painful frequent micturition.

*Family history* was negative no tuberculous no deaths in the family except two from accident. The mother never had any miscarriages.

*Personal history* Has always enjoyed good health and never had any serious illness no renal colic or urinary trouble until the present illness. Denies venereal disease and has had none of the

usual symptoms of secondary syphilis. Menstruation began at the age of 16 and has been regular every twenty-eight days and always painless, no excessive flow at any time. Habits are temperate but admits frequent sexual indiscretion the first time one year ago (which statement might rightly be modified).

Present illness began three years ago as a burning at the neck of the bladder and some increased frequency of micturition. This was slight at first but gradually increased until she sought relief and was treated at intervals for cystitis. She now voids every half hour during the day and five or six times at night sometimes with considerable tenesmus. There has been no incontinence but urgency is marked. The pain at the neck of the bladder is relieved for a few minutes after voiding but soon recurs increasing in intensity. Micturition is very painful and sometimes there is a little delay some straining being required to start the flow. The pain in the bladder is described as a pressure over the organ and a burning at the neck with some pain occasionally to one or the other side of the suprapubic region.

There has never been any hematuria but she thinks that the urine is a little cloudy at times. No pain in the back or over the kidneys or in the legs. No chills or fever and no loss of weight. Menstruation has been regular and painless and the bladder symptoms are very little increased at this time.

On examination the patient appears healthy, well nourished and of good color. Chest and abdomen are negative, except a little tenderness over the bladder. No enlarged lymph nodes.

**Vaginal examination.** The vulva appears normal, the hymen ruptured. No ulcerations or scars are to be seen and there is no discharge from the urethra. Bartholin's glands are not palpable. The uterus and adnexa are in normal position and normal size, and are not especially tender. There is a slight discharge from the cervix which shows a few pus cells, and many gram negative bacilli but no diplococci.

Urine obtained with a catheter is clear and contains no pus cells but a few red blood cells and some pavement epithelium. No bacteria. Cystoscopy was attempted but as soon as 30 cubic centimeters of water had been forced into the bladder the pain was so great that the examination was impossible. The patient was not seen again until April 23, 1915, under anesthesia she had been cystoscoped twice in the meantime but had had no treatment. The symptoms are of the same character as before except that she has to void every ten minutes day and night, and has thus been confined to the house for some time. There has not been any hematuria whatever.

**Examination.** The urine obtained with a catheter is the same as before. The urethra was anesthetized with 10 per cent novocaine. The bladder holds 50 cubic centimeters of water with difficulty.

The scope enters with ease, no obstruction being encountered. The vesical mucosa is seen to be everywhere of a very deep red color and is smooth and glistening. The blood vessels are not to be seen, the urethral orifices are normal, and clear urine is seen to escape at normal intervals. The bladder wall is not trabeculated. The vesical orifice is quite swollen, especially at the left anterolateral portion and is here covered with a livid colored mucous membrane. There are no ulcerations.

Vaginal examination afterward was negative except that the bladder felt thick on bimanual palpation and was very tender.

Careful examination was then made for gonococci but none was found. During the next two weeks the bladder was treated every two or three days by installations of argyrol 10 per cent with no result. On May 13 a small slightly elevated soft red spot was noticed on the left labium major. Syphilis was then suspected and the patient was given mixed treatment mercury and potassium iodide in strong doses and at the same time referred to the laboratory for a Wassermann which she failed to carry out. The antisymphilitic treatment was pushed until June 18 when it had to be stopped because of salivation. She had also had the bladder distended by hydraulic pressure every three to five days during the same period, but it was exceedingly painful, caused bleeding and the capacity never exceeded 210 cubic centimeters.

However she was much better voiding every hour during the day and not more than five times at night. The burning and pain had all disappeared. During the next six months attempts were made every seven to ten days to increase the capacity of the bladder by hydraulic pressure, but it was always very painful and never admitted more than 230 cubic centimeters. On November 1 the bladder was more irritable, cystoscopy showed the vesical mucosa more normal in color with only a few hyperemic patches. The vesical orifice was still swollen and the mucosa here of a livid color. The urethral mucosa was deeply congested and bled readily but no ulcers were to be seen. A ten per cent silver nitrate solution was painted over the urethra and vesical neck and this treatment repeated several times during the next month with some temporary relief.

On April 1, 1916 she returned for observation. She was voiding without pain every two hours during the day and three times at night. On the right labium was seen a small annular eruption typical of an annular syphilid and just above it was a small flat papule similar to the one seen on the opposite side a year before. A Wassermann test was made at once and found to be strongly positive. During the next four weeks the patient received four injections of arsenobenzol 0.4 gram, and mixed treatment in addition.

At the end of this time she was voiding every three hours during the day and not over twice at night and all pain and discomfort in the bladder

ere good. The bladder examined on May 24 showed a normal mucosa everywhere except at the vesical orifice where on the left anterolateral portion it was still a little swollen and the mucosa deep red. The bladder held 150 cubic centimeters with only moderate discomfort but is evidently considerably contracted.

Mercurial treatment has been advised for some time to come.

His report on cerna patient aged when he sought treatment she had suffered with the symptoms of a severe chronic cystitis for five years. With no period of relief there was never any visible hæmaturia there was no history of venereal infection or of the usual manifestations of secondary syphilis but she admitted frequent exposure.

The diagnosis of syphilis of the bladder was made only after the appearance of a suggestive syphilitic eruption on the labia the extremely irritable condition of the bladder and its contracted condition and the very deep hyperemia of the vesical mucosa which was swollen smooth and glossy and finally the presence of a strongly positive Wassermann reaction and the marked improvement after anti-syphilitic treatment.

In regard to the differential diagnosis repeated tests for diplococci were negative even after dilating the urethra and the application to the urethral mucosa of strong silver nitrate solution.

There is a type of chronic urethritis in women which is characterized by the symptoms of a chronic cystitis clear urine with only a few or no pus cells microscopically no urethral discharge and a hyperemia of the urethra and trigone of variable degree. This condition has been well described recently by Shallenberger in the *Journal of the American Medical Association* April 1 1916. These cases are relieved after a few applications to the urethra. The author's case was thought at first to be of this nature.

Kelly (36) describes a condition of hyperemia of the bladder usually patchy or limited to the trigone and associated with considerable urinary distress. He states that the causes of this condition are sometimes difficult to determine. I find it in all those cases which have hitherto been diagnosed as irritable bladder a teasing of the neck of the bladder from retroflexion of the uterus or pressure of an anteverted uterus on the bladder or neuralgia of the bladder it is also the only lesion existing in many cases under treatment for a supposed cystitis. The trigone sometimes has a puffy or oedematous appearance.

In the author's case the uterus and adnexa were in normal position and there were no evidences of adhesions about the bladder. There was no stricture of the urethra and no ulcers on the mucosa. There was no evidence of cord lesion. The ureters were catheterized early and no obstruction found and the renal function on both sides was excellent. Roentgenographs showed no calculi. Tubercle bacilli were also diligently looked for without result.

Syphilis of the bladder is seen more commonly in the tertiary stage the lesions consisting of ulcers tumors or both but in the late secondary stage and in the tertiary stage hyperemia either diffuse or in patches is constant.

This case is unusual because of the absence of hæmaturia and because of the long duration of the disease without ulceration or definite tumor formation unless the marked swelling at the vesical orifice was a gumma.

The absence of ulcers vegetations etc. should not rule against the diagnosis of syphilis. Excessive swelling and hyperemia of the vesical mucosa either diffuse or patchy associated with the symptoms of a cystitis unresponsive to local treatment the absence of all common etiological factors and especially the absence of infection in the urine the presence of a positive Wassermann reaction and the prompt disappearance of all symptoms and lesions after anti-syphilitic treatment should constitute sufficient evidence upon which to base a diagnosis of syphilis.

In conclusion it should be emphasized that primary cystitis is very rare that the most careful search should be made for one or more of the various causes in all cases of vesical irritability and finally in cases of obscure origin especially those associated with sterile urine and marked hyperemia of the vesical mucosa a Wassermann test should be made and if positive anti-syphilitic treatment should be the only medication used.

One should bear in mind also that painless hæmaturia of sudden onset may be due to a well developed tertiary lesion and in all such cases cystoscopy should be insisted upon. Lastly in patients presenting tumors of the bladder and who give a history of syphilis.

the specific nature of the neoplasm must be suspected

As more attention is given to syphilis as a cause of certain urinary disturbances no doubt more cases will be reported and further contributions on the subject would be of great general interest

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## THE SURGERY OF BRONCHIECTASIS

INCLUDING A REPORT OF FIVE COMPLETE RESECTION OF THE LOWER LOBE OF THE LUNG  
WITH ONE DEATH

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MIN. 1907

**B**RONCHIECTASIS is a chronic loathsome disease—generally regarded as incurable. The expectoration is disgustingly profuse; consequently the afflicted loses employment, shuns society, becomes a recluse and not infrequently resorts to dissipation. He is pale and a trifle cyanotic. His fingers and toes are clubbed. He labors with early fatigue. He coughs spasmodically with varying persistency. Stopping laughing, eating, hurrying, flood his trachea with pus and he retires embarrassed to drain himself of abundant sputum. In winter he is periodically ill with severe colds; sometimes with bronchopneumonia; nor does the mildness of summer rid him of chronic cough. He may live many years till cerebral abscess, pneumonia, septicaemia, amyloid disease or hemorrhage happily ends his existence.

A patient with a certain type of bronchiectasis is apt to remark: "I have coughed all my life ever since I had measles (or whooping cough) when I was small. He may say:

"They say I had typhoid pneumonia when I was four or ten years ago I had the grippe and I've coughed ever since." It is probable that bronchopneumonia incident to such infections as the above constitutes the pathology from which develops the chronic state of bronchiectasis.

A foreign body (Fig. 6) may produce bronchial ectases, as is possibly through the interposition of bronchopneumonia.

Bronchitis unrelieved may be attended eventually by dilatation of the tubes.

Chronic abscess of the lung associated with a chronic pneumonic lung lobe will develop a condition in which some dilatation may be present. The term bronchiectasis is frequently applied to such a state.

Fatal bronchiectasis is described as originating in lungs remaining atelectatic from birth.

Chronic pleurisy, chronic empyema and chronic non-tuberculous lung infections are sometimes forerunners to ectases of the bronchi and bronchioles. This relation however is uncommon.

Tuberculosis rarely accompanies bronchiectasis. When both are present the upper lobe is generally the one involved, a fact which would indicate that the tuberculous process is primary and the bronchiectasis a later development (McCrae and Junk).

Tracheobronchial lymph glands may enlarge sufficiently to partially obstruct a bronchus; likewise tumors of the mediastinum and lung. Chronic bronchopneumonia may then be followed by bronchiectasis.

Syphilis may be a cause or at least an accompaniment. Positive Wassermanns are not infrequent in patients with bronchiectasis.

Unfortunately because of its derivation the term bronchiectasis may be applied to any bronchial dilatation whether the latter be an incidental development or the underlying disease. As the clinical picture, the radiograph and the pathologic specimen vary materially in the different types of the disease it is to be hoped we shall employ eventually more specific nomenclature to differentiate the several groups.

It is quite obvious from the specimens shown in Figs. 1, 2, 3, 4, 5 and 6 that the material forming the basis of this paper represent the exaggerated type of the disease.

It is absurd to regard the mere mechanical effect of coughing as the cause of bronchial dilatation of this idiopathic type. The bronchial mucosa becomes infected and inflammation extends thence into the bronchial wall. We are necessarily ignorant of the pathology of this early stage when a bronchitis is becoming a bronchiectasis. If the usual primary bronchopneumonia has been survived the patient lives on at least until the complete pathologic picture of the

advanced disease is provided at autopsy or by lobe resection. Then we find cylindrical ectases of the tubes, scicular neurism like dilatations of the walls, sclerosis of the lung parenchyma and cord like pleural adhesions. The lumen epithelium is cuboidal, the elastic fibers are scattered and disconnected, the cartilages may be degenerated, the submucous vessels are dilated, and the adventitia has become a thick fibrous unyielding layer. We must assume for the present that the bronchial wall loses its tone from infiltrating infection. The diseased mucosa fills the lumen with purulent secretion, the expulsion of which by coughing forces the already weakened bronchial wall to dilate. The subsequent sclerosis of the peribronchial and interalveolar tissue may then by contraction drag the bronchial walls apart and still further pronounce the ectasis.<sup>1</sup>

I must omit here the details of diagnosis. The stethoscope contributes little, the sputum findings are by no means conclusive. The history, however, is most significant and the X ray to say the least confirmative. When clinically the case is probably one of bronchiectasis the X ray rarely fails to reveal both its presence and its distribution (Figs 7, 8, 9, 10 and 11). When however in the beginning differentiation between chronic bronchitis and bronchiectasis is difficult, the roentgenologist is likewise doubtful. Furthermore in cases of advanced and extensive ectasis with fibrosis the radiogram shadow may be homogeneously opaque (Fig 10A), atypical and therefore not distinguishable from that produced by various other lesions.

#### EXPECTANT TREATMENT

The internists' treatment of this disease has consisted in hygiene, climatic influence, vaccines, postural drainage, medicated inhalations and intratracheal injections. I have reviewed carefully the history of such therapies from the period of enthusiasm in England for creosote to the more recent claims for serum treatment. I find no evidence either in history or personal experience to dissuade me from the conviction that all

non surgical methods of treatment have failed to provide more than symptomatic relief of brief duration.

#### COLLAPSE THERAPY

This method of treatment is mentioned solely to emphasize its uselessness. It is not strange that the technical development of methods of collapsing the lung resulted in their employment in bronchiectasis. It would seem—and it is yet difficult to convince some surgeons to the contrary—that forcing the collapse of a bronchiectatic lobe would obliterate the dilatation and scicular lesions, arrest secretion and eventually heal the diseased portions. Ribs have therefore been resected to cave in the chest wall over the infected area. Nitrogen gas has been injected (artificial pneumothorax) to produce lung collapse. An operative pneumothorax has been instituted and the lower lobe separated from its adhesions, thus facilitating the shrinkage. Gauze packs have been placed within the pleural cavity actually squeezing the bronchiectatic lobes. Extrapleural compression has been employed (Tuffier) to force the parietal pleura against the lung.

All these methods have failed to cure. No manner of compression is adequate to collapse the thick walled dilated bronchioles. The effect is as unproductive as would be the pressure of a sponge on a multitude of pipe stems. The total lung volume is unquestionably diminished, the gross secretion is perceptibly reduced, and the patient is temporarily encouraged but he is chagrined to find his permanent betterment trivial after being subjected to an operation of some gravity.

We are forced to conclude, therefore, that collapse therapy—though of unquestionable value in certain types of pulmonary tuberculosis—is useless in cases of bronchiectasis.

#### LIGATION OF THE PULMONARY ARTERY

When the pulmonary arterial blood supply to a lobe of the lung is obstructed (Stierbruch, Bruns), a shrinkage ensues. Microscopically the interalveolar spaces are found to be occupied by an overgrowth of connective tissue resembling a fibrosis. The alveoli are

<sup>1</sup> A paper based on the study of the gross and microscopic pathology of 10 such cases by Robinson and Wilson will appear shortly.



consequently compressed and cease to functionate

It was surmised from these experimental findings that such an operation might be curative in bronchiectasis. Again we are skeptical as to the future of this therapy in the type of bronchiectasis with which this paper deals. The pathologic changes are too far advanced to be rendered symptomless by arterial ligation. If applied in the incipient stage such therapy might well be of definite value.

#### PNEUMOTOMY—DRAINAGE OPERATION

It might appear to be an oversight were pneumotomy omitted in this discussion; nevertheless it is not entitled to a place in the therapy of bronchiectasis. Drainage is yet persistently attempted because of the traditional confusion between bronchiectasis and abscess of the lung, also because of the prevailing conviction, often difficult to overcome, that a pint of sputum must represent a large abscess cavity. Abundant sputum may come from cylindrically dilated bronchioles presenting not even minute cavitations; it may arise from twenty or thirty sacculations not larger than a lima bean (Figs. 4 and 5) or it may be expelled from three or four cavities each 3 to 4 centimeters in diameter. Obviously the drainage of such cavities must be of little avail because of the immediate proximity of others. Bronchiectatic cavities are rarely confluent; the surgical opening of one does not necessarily mean the drainage of several. Yet one may read of patients cured by such operation; many isolated cases and sometimes groups of two or three. Careful analysis of these provokes suspicion that the operator may have been dealing with abscess rather than true bronchiectasis and one is often left in a quandary as to the late results. Mosler collected the reports of 19 cases and though eager to prove that a drainage operation is curative his interpretation is open to dispute.

A true conception of the pathologic anatomy of bronchiectasis will not permit of any faith in the effectiveness of drainage operations. I have attempted this in three cases with direful results; autopsy only exposed

the absurdity of my plan of attack (Figs. 4, 5, and 6). It is in the advanced septic cases with involvement of most of one lung and in which excision is out of the question that one is tempted to drain in the hope of relieving toxemia. To enter the lung and strike pus seems at the moment gratifying. However wound drainage is compared to mouth drainage is absurdly trifling. The patient's equilibrium despite chronic sepsis is upset. A negative phase is apt to follow to which both heart and kidneys may succumb. Hemorrhage slow but constant is not an uncommon sequel which is apt to defy attempts at control.

#### PNEUMECTOMY

I believe that there is but one curative treatment of true bronchiectasis—excision of the diseased lung tissue. The group of suitable cases however is small. A young adult with a basal process confined to one lower lobe with profuse sputum offensive but not fetid with slight if any rise in temperature with loss of weight but without emaciation with a normal heart and properly functioning kidneys—this is the type of individual in whom lung resection properly executed is attended with good chance of cure. It matters little whether the disease is of the cylindrical ampullary or large cavity type provided the general condition of the individual is as specified. Not more than one in every ten cases of bronchiectasis entering a hospital clinic represents this favorable type. The remaining nine are unsuitable; one may be a rachitic child with low resistance; several may have extensive involvement of both lungs; another a local process in an inaccessible part of the upper lobe; another nephritis; and the remainder may be poor surgical risks because of extensive peribronchial disease, secondary infection, and gross cavitation.

As time goes on the definition of a suitable case for excision will be less specific. Childhood and even infancy may be excluded from the contraindications. In cases in which the disease involves both bases it is not impossible that excision may be performed on one side and subsequently on the other. Moreover eventually the technique may be so

abbreviated that even septic individuals with complications may be regarded as suitable risks

### LUNG LOBE RESECTION

The problem as to the necessity of dividing lung lobe resection into two or more stages may long remain unsettled. The successes in animal experimentation are perhaps misleading. The removal of a lung lobe from the normal dog in one clean operation without drainage is simple to the extreme. The insult to respiration and pulmonary circulation during operation is obviated by apparatus. The tight primary closure of the chest prevents postoperative disturbances in the remaining lung function and in the heart action. Lung infection is not a danger.

In man with diseased lungs and pleura the same one stage lobe resection has often been attempted. The mortality is at least 90 per cent. The operation itself is generally withstood with and without apparatus but difficulties are apt to arise within twelve hours. The remaining lung function suffers badly. The air exchange is insufficient. A fluttering mediastinum may be responsible though probably not. The pulmonary circulation is upset. The right heart is overworked. Toxines are absorbed. Death may follow. And vaguely we conclude that the alveolar carbon dioxide content has been increased for lack of proper breathing and the oxygen content of the blood lowered for lack of proper capillary circulation in the lungs. Be this pathologic complex what it may it is now a familiar and gruesome picture in thoracic surgery.<sup>1</sup>

The fact that an occasional success has attended this one stage lobe resection in man is not an argument that it should yet become the chosen method. It were better first to produce thoracic pathology in animals and study methods of overcoming it.<sup>2</sup>

At present writing it appears to be safer and saner to divide lobe resection operations into more than one stage. The thoracic cavity seems to prefer gradually to accustom itself to new conditions. The history of

successful lobe amputation is instructive. Until recently excision accidentally occurred as the final operation of a series. Those preceding were performed for drainage of a supposed abscess. The lung was contracted and subsequent empyema had been drained.

Plastics for cure of the empyema had produced chest wall collapse. The lung disease having meanwhile continued a shrunken lobe was cut away as a final exploit. Thus have been recorded lobe amputations which were never intended when the preliminaries were performed. Nor did the operators realize perhaps that the preliminaries were responsible for the success of the amputation.

Probably the secret of success in the several stage method lies in the fact that almost any operation on the thorax which opens or even exposes the pleura over a considerable area results in the formation of adhesions. When the pleura is opened in bronchiectasis the diseased lobe invariably is found adherent to the diaphragm pericardium and basal parietes. If before such adhesions are entirely separated an interval of time is allowed before the lobe is amputated the normal lung tissue may be made to adhere. The mediastinum thickens and becomes less mobile. The diaphragm takes a new and higher position. The chest wall contracts. The lung of the sound side learns of its vicarious duties. The pulmonary circulation gradually adapts itself to a less inflated and less mobile lung and becomes accustomed to the gradual loss of the negative intrathoracic pressure upon which it physiologically leans.

With these adjustments first accomplished subsequent amputation becomes less a disturber of the peace.

### LOWER LOBE RESECTION (TWO-THREE STAGE) FIRST STAGE

Immediately before entering the operating room the patient should lie for an hour on a bed the foot of which is elevated. Coughing is then aggravated by the secretion which gravitate to the trachea and the bronchial tree is at least partially emptied. Ether should be given by the drop method. An amount adequate to keep the patient in

<sup>1</sup>It should be emphasized that the dangers occasioned by one stage lobe resection are by no means equally threatened in excisions of part of a lobe. Such excisions may be done in one stage.

<sup>2</sup>A paper entitled "Experimental Bronchiectasis" by Samuel Roberson and Frank C. Mason will appear in the *Johns Hopkins Bulletin*.

position is unfortunately sufficient also to lessen bronchial reflexes and to prevent coughing. Thus is permitted the accumulation at and above the bronchial bifurcation of the ever present profuse bronchial secretion. Marked cyanosis results and persists. At frequent intervals the anesthesia should be light enough to awaken a cough which alone without expectoration will clear the bifurcation sufficiently to admit air to the sound lung. In this manner the cyanosis may be lessened. At best the appearance of the patient is bad such as in most operations would be attended with other alarming symptoms.

*Tracheobronchial aspiration.* On three occasions I have introduced the tracheal tube and have applied suction to it intermittently with a motor driven aspirating outfit. Either given as usual with the mask or inhaled around the tube. This suction mechanism disposes of much secretion and modifies the cyanosis. If one cannot promptly perform intratracheal intubation the tube may be put through the nose to the pharynx from which the suction device will remove the pus which wells up from the trachea. This intrapharyngeal aspiration however fails to remove the flooding at the bifurcation where relief is most needed. The time used in providing for removal of secretion is well expended.

*Intratracheal insufflation differential pressure.* I regard as superfluous the employment of artificial aids to respiration during the two stage operation of lobectomy for bronchiectasis. Neither insufflation nor differential pressure was used in any of the five cases herein reported.

*Incision.* The incision is crescentic with its convexity downward (Fig 12a) starting at the level of the fifth or sixth rib from the vertebral column it crosses the eighth rib in the scapular line and terminates at the level of the sixth rib in the mammary line.

The skin and fat are dissected upward from the muscle for an inch. Vessels are clamped and tied. The latissimus muscle fibers are separated vertically to admit long bladed curved muscle clamps which are applied in series above and below in the

direction of the sternum and again toward the vertebral end of the wound. The muscle fibers are then divided transversely between the clamps.

A wet salt square is then applied to the edge of the skin and muscle flap the clamps being wrapped within it. The second assistant standing by the patient's shoulder retracts the flap and elevates the inferior angle of the scapula (Fig 12). Meanwhile the intercostal branches entering the muscle are clamped and tied.

The field thus exposed should permit the uppermost resection of the seventh eighth and ninth ribs from their angles to the anterior axillary line. The intercostal bundles are then ligated and removed (Fig 12B).

Scapular retraction is omitted. The muscle clamps are all removed and a continuous locking catgut stitch is taken along the upper and lower cut muscle edges.

This stitch is solely for hemostasis the muscle ends are not sutured together. It is difficult to apply the locking hemostatic stitch at the beginning before dividing the muscles.

The skin is now closed tight with figure of eight tension silk worm gut sutures and a running horse hair stitch.

A graded compression pad made of folded gauze is applied to support the area of chest wall denuded of ribs. Three adhesive straps (2 inches in width) are placed to render the pad an effective buttress. The usual dressing is applied with more straps over riding the sternum and spine.

While generally such an operation is not followed by symptoms of shock considerable blood loss is inevitable and the patient is in no condition to bear the added insult of pleurotomy and handling of the lung.

Much has been accomplished however by this first stage. The thoracic window has been made ready to open. The chest wall collapse necessary for the subsequent obliteration of the space left after amputation of the lower lobe is provided. Something has been learned of the individual's resistance to surgical trauma of his tolerance of anesthesia and of the amount of flooding by tracheal

secretion that is to be managed in his particular case

The sole danger after the first stage is undue retention of purulent secretion. Coughing is painful, the expulsion of sputum more so. The *vis c tergo* provided by the chest wall in expulsive coughing is reduced by the operative defect though somewhat restored by the compression pad.

Postoperative treatment then should consist in (1) moderation in the use of morphine lest coughing be unduly withheld (2) such periodic postural therapy as may aid in drainage of the bronchial tree (3) constant renewal or tightening of the compression pad and supporting straps (4) early sitting posture and (5) an abundance of fresh air.

## SECOND STAGE

The interval prior to the second stage should be approximately a week in length. The power of expelling sputum should have been restored, all trace of shock should have disappeared and the temperature should approach normal.

The anæsthesia, tracheobronchial aspiration and other preliminaries are established as before. The skin stitches are removed, the scapula and flaps retracted and the pleura again inspected. It will be found that in the upper part of the exposed field there are new pleural adhesions anchoring the upper lobe. The lower lobe is still adherent at various places, now somewhat retracted and purple red in color. The pleura is opened wide at any point whether adherent or not. There will be no particular change in respiration or pulse.

The separating of adhesions necessary to deliver the lower lobe is generally irksome. It is the difficult part of the operation. The lower lobe is generally bound to the diaphragm and costodiaphragmatic angle by tough unyielding bands which may not yield under digital pressure (Fig. 13). If undue force is used in stripping the lung surface will tear before the adhesion gives way. Some of these should be cut. It is well, therefore, to free the lobe first from all but its diaphragmatic attachments so that if bleeding occurs during the separation of the latter a clamp may be applied tem-

porarily in the region of the lobe hilus. The interlobar fissure does not always provide a simple cleavage nor is it advisable to employ too much force in this region lest the light adhesions be parted which by now should be holding the upper or middle lobes to the parietes. The pericardial surface is at least troublesome of all.

If at any time during this process of liberating the lung lobe disturbances in respiration occur the U shaped skin and muscle flap is promptly swung down to cover the pleural defect. It is jammed against the chest wall with the palm of the hand until towel clips are applied bringing the skin edges together for a temporary air tight closure. The stimulating effect of this procedure is almost immediate. A slight negative pressure is restored to the operated chest during the inspiration, the upper lobe receives some air, the mediastinum is held in better position because of greater equality in the intrathoracic pressure of the two sides. Consequently the sound lung functions better.<sup>1</sup>

In Cases 1, 2 and 4 it will be noted that the second stage was closed in the midst of this separating of adhesions. In Case 5 however this performance was completed and amputation done at the same sitting. As one becomes familiar with the lay of the land, the necessity of three stages is diminished and yet to stop the operation at the middle of the second stage and to defer the completion of adhesion stripping and amputation to a third stage is a conservative measure not to be regretted and one which in difficult cases may save the patient from undue hemorrhage, shock and carbon dioxide poisoning.<sup>2</sup>

It is not until one has worked in the open pleural cavity with his patient persistently cyanotic (a necessary condition in etherized bronchiectatic patients) that he will realize the consolation to be gained from the knowledge that the operation may be safely stopped at any moment in the second stage.

If however the second stage progresses favorably so that it may include amputation at least one distinct advantage has been gained, namely that the patient will then have been rendered practically sputum free.

<sup>1</sup>The necessity for such interruption I have experienced but once in a life-time on an operation. The result on one of our isolated cases did not follow. (see Case 4)

<sup>2</sup>The delay in this case was largely totally responsible for the recovery in at least two of my earlier cases.

and the postoperative convalescence will not be complicated by the retention of purulent secretion—the expectoration of which is even more difficult after the incompleting second stage of the operation than after the first.

#### AMPUTATION

If there has been no occasion to close the second stage prior to the complete delivery of the lower lobe amputation is promptly performed as follows. A long curved clamp is applied to the root and closed to the last notch. The lobe is then amputated at least a half inch distal to the clamp. The veins, arteries and bronchi are then picked up separately and ligated with No. 2 chromic catgut. A mass ligature of kangaroo tendon or brided silk is then placed just proximal to the clamp and tied as the clamp is slowly released the ligature being guided into the crushed area evacuated by the clamp. Not infrequently two clamps are necessary safely to include the whole stump. It is apparently an equally satisfactory method to leave the root clamps *in situ* and to remove them on the seventh day (Case 5 Fig. 14).

Either of these methods of amputation results invariably in subsequent leakage of the bronchial stump. The portion distal to the mass ligature or clamps sloughs away within a week or ten days leaving one, two or three fistulous openings of small caliber. Experience will prove whether or not it is expedient to attempt any special technique for hermetically closing the bronchus at the time of amputation. The bronchus at the point of division is generally dilated its walls are thick, tough and unyielding. It is probably not amenable to such treatment as invagination and end suturing as has been successful in normal animals. If treatment of this kind were attempted it would necessitate the isolation of the bronchus from the vessels in the hilus, the individual double ligation of the vessels before their division and the crushing division, crutORIZATION, invagination and suturing of the bronchus. Neither the clamp nor mass ligation could be employed. In the present period of undeveloped surgery of the diseased lung it would seem more proper not to sacrifice time at the end of a

critical operation by any finesse in the treatment of the bronchial stump which in its pathologic condition would stubbornly resist any technique of closure.

The minute fistule consequent to the clamp and mass ligature technique in no way complicate the convalescence. The pleural space is rapidly obliterated the fistule remaining the only unhealed points in the wound. By local plastic surgery under local anesthesia the fistule are closed later by the superimposing of skin and fat flap.

The after treatment of the second operation is simple. Bronchial secretion is no longer a cause of anxiety. Within the first two days the bronchial tree becomes free from the residue emptied into it from the lower lobe just previous to its removal.

With return of consciousness the patient discovers that the promised reward of his long siege of treatment is now a reality. The sudden freedom from a cough of perhaps ten years duration is a stimulus mentally and a boon physically.

The patient is not disturbed for four days by which time it is foul. At least two thirds of it can then be removed painlessly. When firmly adherent to the raw surfaces of the punctal pleura fragments of the gauze should be left till they have sloughed away. A great precaution is taken at each dressing to recheck the persisting pleural space completely lest pocketing occur in the costo-phrenic angle or about the pericardium or posteriorly below the lower limits of the neighboring lobe. At no time in the convalescence should drainage tubes be substituted for gauze. The skin opening has been so designed that it will not close until the cavity is obliterated. Irrigation is never indicated. Granulations may be stimulated with bulim of Iodo. The pleural space remaining after excision of the lower lobe having been already diminished by the shrinkage of fibro is attendant upon the first two stages may now be obliterated within four months. The patient meanwhile attains a body weight equal to his previous maximum and this continues to increase rapidly during the months following closure of the wound.

## THE OPTIONAL INTERMEDIATE STAGE

If, in the course of separating the lower lobe from its adhesions during the usual second stage of lobectomy indications arise for doing the operation before amputation the whole procedure is converted into one of three stages. A gauze pack (6 inches wide 8 thick) is then fed into the unoccupied portions of the pleural cavity in such manner that the partly delivered lobe may not adhere again to the structures from which it has just been separated. Care should be taken that the entire costodiaphragmatic angle is packed—that the pericardial surface is protected—that loops of the pack are interposed between the lobe and the costal pleura lastly that any pleural pocket produced by retraction of the upper lobe be likewise filled with gauze. In placing the pack care is taken to fill all the spaces and to do so with moderate pressure only. If a pleural area is overlooked adhesion bands may form subsequently and encapsulate a local empyema (Cases 2 and 5).

The lower lobe shrunken by disease is now almost completely collapsed. It is surrounded and jacked up by the gauze pack in such fashion that there is some tension at its root. This adds stability to the mediastinum and also prevents undue retraction of the neighboring lobe.

The cavity filled with gauze is closed tight without drainage. The flap is sutured in place with interrupted figure of eight silk worm gut sutures taking in skin and muscle. A running horse hair stitch is added to hermetically close the wound. The dressing is applied with a graded compression pad and adhesive, as after the first stage of the operation.

The gauze packing and the tight closure of the wound are important factors during the first two days of convalescence. They serve as a buttress to the healthy lung lobes as well as to the bronchiectatic lobe. Coughing is rendered effective in expulsion of secretions. The pack takes up any infection which may have escaped from the diseased lobe during its liberation and hastens the anchoring of the upper and middle lobes in their new position by adhesions.

During the first twenty four hours the wound and the gauze pack should not be disturbed lest a wide open pneumothorax further restrict the efficacy of breathing and the *is c t ergo* to expulsive coughing be sacrificed. Nevertheless the onset of hydrothorax must be assumed and provided for just as soon as it is evident that the patient can dispose of his sputum despite the reopening of the wound and the loss of chest wall support. This time arrives between the third and seventh days. It is well first to open a half inch of the wound and allow the effusion which will have overflowed the pack slowly to leak out. This will relieve the patient of an intrathoracic tension which is painful and which must always be relieved before it becomes excessive. Gradually then on the following day the removal of the pack is started and finally completed in two subsequent daily sittings. When the pack is entirely removed it must be carefully replaced a procedure which necessitates wide opening of the wound with retraction of its edges. A drop light is essential for the inspection of the pleural space in order that every unoccupied portion may be refilled with gauze otherwise an overlooked pleural pocket may produce a local empyema. Furthermore new adhesions will form between the collapsed lobe and costal pleura at any point where the packing is not replaced. The dehydration coincident to the profuse secretion of the pleura becomes apparent in the patient's facies causing a marked pallor which persists for several weeks.

One is astonished at the rapid obliteration of the new pleural space around the collapsed lobe. Although the discharge becomes purulent and the cavity to all appearances is an empyemic cavity it lacks the proverbial stubbornness to obliteration of an empyemic cavity. On the contrary the space is rapidly filled by elevation of the diaphragm, by partial mobilization of the mediastinum and by healthy pleural granulations.

The management of the interval following the second stage in a three stage lobectomy cannot be followed by rule or schedule. Certain dangers are to be obviated certain steps are to be taken but the indicated and oppor-

tune moment for each must depend upon the progress of the particular case in hand.

I am convinced now that in the three stage lobectomies included in the case reports an undue interval was permitted between the second and the third stages. Two to three weeks should be sufficient.

The third or amputation stage of the three stage operation is no more nor less than the latter half of the second stage of the two stage operation already described. The separating adhesion is completed sufficiently to deliver the lower lobe which is then amputated.

#### INTERCOSTAL LOBECTOMY

To open the thorax without the resection of ribs by the technique which Mikulicz and Sauerbruch first utilized in experimental surgery is unquestionably the ideal method. The intercostal incision followed by rib spreading together with the division of one or two ribs permit a perfect exposure for any intrathoracic operation. Lobectomy through such an opening has been universally successful in animal. Lilienthal reports five complete lobectomies by the intercostal route in man with two deaths. Certain other surgeons have had a 100 per cent mortality with the same technique.

One is instinctively loath to adopt a technique associated with high mortality in the hands of competent technicians when a different technique though infinitely more laborious has resulted in but one death in five cases.

It is fallacious to argue that a person with bronchiectasis is too wretched to live and that a surgical death is a permissible hastening of his exitus. On the contrary such an individual should not be made the subject of great operative risk as in cases of malignant disease. As wretched as his existence may seem to others the unfortunate afflicted with bronchiectasis would probably never submit to an intercostal one stage lobectomy if he knew in advance the present mortality of such an operation. The 20 per cent mortality of the two three stage rib resection lobectomy stamps it today as an operation which may be conscientiously advised. Nevertheless be this as it may the total number of recorded

cases is yet too small to warrant the conclusion that the intercostal lobectomy may not yet become the operation of choice. It is conceivable that the eventually accepted technique may be a combination of the several stage advantages of the rib resection lobectomy with the technical advantages of the intercostal lobectomy. Further experience may develop a method by which the intercostal technique may be combined with the two stage idea in such fashion that the added simplicity of the former coupled with the protective physiologic effect of the latter may provide a method more ideal than either alone.

The technique of intercostal lobectomy is therefore herein described together with a discussion of methods of obviating some of its chief dangers in order that this paper may not fail to mention an operation which in some modified form may become eventually the operation of choice.

#### TECHNIQUE OF INTERCOSTAL LOBECTOMY

Some form of mechanical aid to the respiratory function is indicated in this particular type of operation. Intratracheal insufflation alternating at opportune moments with tracheobronchial aspiration may be used. The employment of differential pressure is particularly indicated in bronchiectasis cases because of the profuse secretions. However such apparatus is rarely available.

The incision follows the seventh or eighth intercostal spaces from the rib angles to the costochondral articulation. The skin and fat are dissected away from the muscles for an inch above and below the incision. The muscles are divided the length of the incision the vessels ligated. Both layers of intercostal muscles are cut a distance of 2 inches at the center of the wound the parietal pleura being thus exposed. The pleura is then nicked air being allowed to enter slowly as the opening is closed intermittently with the finger. As respiration adjusts itself to the open pneumothorax the intercostal muscles and pleura are divided to the ends of the wound care being taken that the cut is made midway between the ribs to avoid injury to the intercostal vessels.

Again it is well to pause to note the effect of wide open pneumothorax on the particular patient in hand. A rib spreader is introduced. If the ribs cannot be separated sufficiently to permit access to the diaphragmatic and pericardial regions the seventh rib is divided at the anterior end of the incision; it may also be necessary similarly to divide the eighth rib. The lower lobe is then separated from the adjoining lobe, the diaphragm, costal pleura and pericardium.

At the completion of this generally laborious task the patient's condition may be questionable. If the cyanosis is marked or the pulse of poor quality, the rib spreader should be removed, the ribs pressed together and the skin edges apposed with clamps or towel clips. Even if such temporary closure is not air tight, the lung function is enhanced and the right heart is relieved. In the absence of response to such stimulation it may be well to close the wound and postpone amputation.

If the patient's condition warrants proceeding, the lobe is ligated and amputated in the fashion described.

The spreader is removed and the wound closed promptly as follows. Pericostal sutures (Sauerbruch) previously prepared of strong silk threaded in long half curved slender round needles are placed  $1\frac{1}{2}$  inches apart. The two adjoining ribs, intercostal muscles and pleural edges are enclosed in these stitches. Each pair of suture ends is caught in a separate clamp.

These clamps are held aloft by an assistant in such a manner as to tighten the sutures and approximate the ribs as the surgeon ties. Previous to the tying of the end suture the assistant relaxes the tension and a closed clamp is wedged between the approximated ribs to permit the free in and out going of air. At the end of an expiratory movement (if no apparatus is being used) the clamp is suddenly withdrawn, the suture drawn taut and hastily tied.

When differential pressure is being employed it is exaggerated at the final moment of closure. If an intratracheal insufflation is in action the outflow of air around the tube is obstructed momentarily at the end of respiration by bilateral compression of the trachea.

Each of these maneuvers tends to reduce the volume of air remaining in the opened half of the thoracic cavity and consequently to partially inflate the lung. In the first instance (without apparatus) the chest wall at the end of expiration collapses upon the lung. In the latter instance (when positive or negative pressure apparatus are in use) the lung is inflated at the moment of closure, the air thus being driven out of the cavity between the jaws of the opened clamp. In intratracheal insufflation a sudden obstruction to the air outflow likewise inflates the lung.

When the last pericostal stitch has been tied by the method described, the divided chest wall muscles are brought together with a running catgut suture. As it is important that the muscle approximation should be made strong, it is well to interrupt the continuous suture with ties at three points in its course. The skin is closed with a running silk suture. The first few layers of gauze in the dressing should be held snugly to the wound by a strip of adhesive half encircling the thorax. The closure in layers tends to seal any leakage which may occur between the pericostal ligatures. Pressure to the dressing prevents hæmatoma, which might separate the layers and destroy their hermetic sealing effect.

To restore the remaining lobes of the lung to a state of at least partial inflation at the end of the operation is to restore also part of their function—not because inflation is such, is of value, but rather because inflation is visible evidence that the intra-thoracic pressure which was atmospheric during the operation has been converted into a negative pressure at the close of operation. Without such negative pressure the lung of the operated side cannot functionate adequately.

Nor would the loss of the function of one lung alone be disastrous necessarily were it not for the fact that in contrast to the normal negative intrapleural pressure of the sound side the lack of negative pressure in the diseased cavity which prevents the inflation of the diseased lung also permits a slumping of the mediastinal partition toward the sound side at inspiration and thus prevents the filling of the otherwise undisturbed lung. At expiration the mediastinum balloons toward the wounded half of the thorax.



The sound lung therefore is not emptied of its gaseous waste product (CO)

Lisenthal applies a fixation ligation to the stump of the lobe. This is brought into the wound drawn tight and fixed.

The greater the oxygenating power of the lung the less hectic will be the first twelve hours after the operation. Hence the importance of primary tight closure of the chest even though its reopening be subsequently imperative.

Great stress is laid upon the maintenance of proper breathing because the circulatory equilibrium is definitely dependent upon it. Heart stimulants may appear to improve conditions but when the respiratory compensation is broken cardiac and circulatory disturbances must follow sooner or later.

The relation of pulmonary blood pressure to lung inflation has been the subject of much dispute and some experimentation. The amounts of blood contained in an inflated lung and in a collapsed lung have been measured and compared. My own experimental conclusions in this regard have agreed with those of certain observers and differed from those of others. By means of a long cannula introduced through an opening in the internal jugular vein to the right auricle and between the tricuspid valve to the right ventricle I recorded the pulmonary blood pressure. A cannula in the left carotid artery recorded simultaneously the general blood pressure. The respiratory excursion also appeared on the kymograph tracing.

One pleural cavity was then opened. Both blood pressures remained unchanged until the opening was enlarged whereupon the lung collapsed in creased and the pulmonary blood pressure declined. The fall in blood pressure was synchronous with and proportionate to the onset of dyspnea. As the respiratory embarrassment was overcome and the lung re-inflated by artificial means (positive pressure) the pulmonary blood pressure returned to normal. Had the same experiment been performed with the use of intratracheal insufflation to restore the respiratory equilibrium the blood pressure would doubtless have returned similarly to normal. Insufflation will maintain oxygenation without inflation from which we must infer that the fall in pulmonary blood pressure incident to wide open pneumothorax in a dog is not due to the lung collapse *per se* but rather to an extensive reduction in its function of oxygenation.

In other words the quantity of blood in the collapsed lung be it increased or decreased probably has little to do with the changes in heart action following wide open pneumothorax provided the proper air exchange is maintained artificially.

The slowing of the pulse and lowered pulmonary blood pressure accompanying the dyspnea associated with wide open uncompensated pneumothorax may result from the stimulation of the cardiac inhibitory center by an excess of carbon dioxide. The actual relation of the circulatory to the respiratory functions in the presence of an open thorax is an unsettled problem in pathologic physiology.

#### DRAINAGE IN ONE STAGE LOBECTOMY

The bronchial stump is a source of infection. A suitable culture medium is provided by the hemorrhagic effusion which collects in the pleural space after operation. There is necrotic tissue both in the bronchial stump and in the stumps of adhesion bands which were cut away during the liberation of the lobe. All factors favor the progress of pleural infection.

Nevertheless in the first 24 hours of convalescence the suction of the chest wall is imperative. To destroy this by the addition of an open drainage is to sacrifice one of the chief promoters of recovery. It is well therefore before closing the intercostal suture to make a one half inch incision in the posterior axillary line overlying the intercostal space which the intrathoracic guiding of the finger indicates as corresponding to the very bottom of the pleural space. An opening is then made from the incision through all the chest wall tissues into the cavity. Through this a 4 inch rubber tube is passed which projects 1 inch into the space. Two silk worm gut sutures are taken to approximate the skin closely about the tube which is corked or doubled over and tied or clamped. The intercostal thoracic wound is then closed as described. A spigot as it were is thus constructed which may be opened with suction applied as occasion arises. If the lung collapse is later extreme the intrathoracic pressure may be rendered negative by sucking the pleural air out by this tube simultaneously such fluid as may be present will be withdrawn.

If untoward symptoms develop a few hours after operation effective restoratives are often sought in vain. The combined circulatory and respiratory embarrassments are woefully unresponsive to stimulation. For labored breathing a sitting posture fresh air

and oxygen are helpful For labored heart action, irregular and compressible pulse and low blood pressure caffeine camphorated oil digitalis proctoclysis, and hypodermoclysis should be administered

#### CONCLUSIONS

1 Advanced bronchiectasis cannot be cured by medications inhalations intra tracheal injections intratracheal irrigations climatotherapy or vaccines

Collapse therapy produced either by nitrogen artificial pneumothorax or by surgical measures is not curative

3 Pulmonary arterial ligation is of more definite value as a preparation for lobectomy than as a curative measure *per se*

4 Excision of the diseased portion of one lung is the only curative treatment of advanced bronchiectasis

5 In the present status of the development of thoracic surgery lung resections should be performed in a two or three stage operation The several stage operation of the rib resection type has been attended in the writer's experience with a 20 per cent mortality

6 The operation of intercostal lobectomy has distinct technical advantages When performed in one stage an undue risk of life is incurred The physiologic advantages of the several stage technique may yet be successfully combined with the technical advantages of the intercostal exposure

#### CASE REPORTS

CASE 1 (See *Annals of Surgery* 1912 lv 512 Included in this series by courtesy of the Massachusetts General Hospital) J R C age 36 dredge man Lucas nineteen years previously two years of treatment Cough for 2 years Twenty months ago a period of dyspnoea Sixteen months ago took cold fever chills dyspnoea night sweats Cough increasing in past 14 months accompanied by thin purulent sputum Fourteen months ago 55 ounces of fluid aspirated from chest with some relief of dyspnoea

December 1908 Left chest flatness absence of fremitus and breath sounds from fifth to seventh ribs anteriorly and below the inferior capular angle posteriorly Right chest normal

Weight 148 pounds temperature 98.6° pulse 90 leucocytes 12,000 Sputum greenish mucopurulent Influenza bacilli present also a few pneumococci Tubercle bacilli absent

January 28 1909 Pneumotomy W M C Lung grayish in color and of tough consistency Section removed with considerable hæmorrhage Pathologist's report Lung tissue more or less solidified Diagnosis chronic bronchopneumonia

May 1909 Rib resection for drainage of empyema following pneumotomy

October 18 1909 Since last operation patient has had two exacerbations with high fever and leucocytosis Discharge now profuse from empyema wound General condition improved

Lobectomy (S R) First stage Anaesthesia ether anaesthol oxygen A curved incision with its convexity upward to include the scars of previous operations and the drainage wound Muscle and skin flap reflected downward posterior ends of ribs previously excised removed sufficiently to admit the hand freely into the pleural cavity Adhesions extensive preventing any indications of empyema raised respiration Both upper and lower lobes separated from the parietes with considerable difficulty and some bleeding Adhesions in fissure between upper and lower lobes also broken up

Although patient's condition was not alarming it seemed advisable to complete excision of the lower lobe at a second stage operation The entire lung was packed away from the parietal pleura except at the apex with handkerchief gauze The lower lobe appeared to be of firmer consistency than the upper although the latter was firmer than normal The patient recovered from the preliminary operation during the following thirteen days in which time the original gauze packing was not disturbed

November 1 1909 Second stage Anaesthetic anaesthol ether and oxygen Incision of last operation lengthened to 10 inches More of eighth and ninth ribs removed permitting free access to the entire lower half of the chest cavity Removal of the gauze exposed the lower lobe free from adhesions The lower lobe was then clamped 13½ inches from its root Amputation performed distal to the clamp The clamp then slipped from the unyielding lung tissues permitting profuse hæmorrhage from several points in the stump together with leakage of air through exposed bronchi The large vessels were clamped separately and a mass braided silk ligature applied around the root of the lower lobe Patient's condition somewhat threatening Large gauze pack placed in pleural cavity around amputation stump Skin and muscle flap only partially replaced with through and through silk sutures

Convalescence from second operation surprisingly good

Fourth day after operation Patient subjectively in better condition than for many months

Eighth day after operation Gauze removed without hæmorrhage also silk stay suture Tenth day Patient out of doors in wheel chair sleeping well Seventeenth day Wound cavity visible and clean with no sloughing patient walking

December 7 1909 Evidences of bronchial leak

ge in the stump disclosed by whistling noise during coughing. Coughing since operation has been slight up to this time. No sputum.

June 3, 1911. During past year and half patient's general condition has been distinctly better than for the past four years. The skin flaps left unsutured have retracted into the exposed cavity and become adherent in better position than if they had been sutured to bridge the cavity. New skin has extended inward from the flaps sufficiently to cover the base of the cavity with the exception of two square inches in the midst of which are four small bronchial fistulae. Exploring these fistulae with a probe causes a reflex spasm of coughing during which the diaphragm from below and the mediastinum and the heart from within bulge prominently. There is a slight mucopurulent discharge from these fistulae but the reflex cough is not accompanied by sputum.

July 7, 1911. Plastic operation for closure of fistulae only partially successful.

In 1913 four years after lobectomy a report was received at the Massachusetts General Hospital that patient had died in New Brunswick of pneumonia. The details of death were never obtained.

CASE 2. Cylindrical and saccular bronchiectasis of lower lobe (Figs. 6). H. S. No. 3341. Age 34 waiter. Alcohol and tobacco used in excess. Lesion on penis eight months ago diagnosed by local physician as luetic. No history of gonorrhea obtained.

Cough of ten years duration during from an abscess of the lung. At that time a large quantity of pus were expectorated for six weeks. Following this patient in moderately good condition except for a slight cough. Four months ago cough became more aggravated accompanied by recurrent fits of foul sputum. Some dyspnea occurred at night which would be relieved by the expectoration of half pint of pus. During past month slight fever and three to four sweat at night. Cough constant during day with profuse expectoration. Has lost some weight. Examination of lungs by auscultation. Marked dullness diminished fremitus and diminished breath sound at right base. Signs of cavity. Many rales and rhales heard over both sides of chest most marked over right side and possibly originates entirely from it. Roentgenogram (stereoscopic). Bronchiectasis on right with multiple cavities at right base (Fig. 7). Wassermann reaction negative. Sputum examination Gram stain pneumococci plus cells. Micrococci catarrhalis. Blood agglutinates. Pneumococci No influenza bacilli.

March 7, 1915. The right lower lobe was resected.

First stage. Five inches of the seventh eighth and ninth ribs resected. Pleura opened while lower lobe freed from its adhesions. Diaphragm adhesions not resistant. In order to prevent complete lung collapse the anterior border of the diaphragmatic surface of the lower lobe was sutured to the upper

border of the thoracic window. A gauze pack was then placed in those portions of the pleural cavity not occupied by the partly collapsed lung. The skin and muscle flap was sutured in place without drainage.

The patient was cyanotic both before and after the opening of the pleura and remained so until coughing reflex returned and the secretions collected in the trachea were expelled.

Six days after operation the stitches were removed and the gauze pack withdrawn. It was soaked in serum some of which had packed between the stitches. The lower lobe suture held accordingly its diaphragmatic surface fully accessible through the wound. The gauze pack was renewed daily.

Two weeks after operation openings were made with a clamp in the under surface of the lower lobe as it presented in the wound in the hope that at least some purulent secretion might thus escape and reduce the quantity of sputum which was now difficult to raise. A temporary discharge followed through the fistula thus produced but with no material relief to expectoration.

In the following two weeks a septic condition developed with fever leucocytosis. Loss of weight. Examination of the wound revealed nothing. Chest examination as unsatisfactory because of the peculiarly altered conditions in the right pleural cavity. The left lung however appeared to be normal. Pus was obviously present but there was no clue as to its location. Fortunate a new discharge from the anterior end of the wound disclosed a tract connecting the walled off portion of the pleural cavity adjacent to the mediastinum and pericardium.

April 16, 1915. Under ether localized empyema drained and packed. A prompt operation followed with gain in weight.

June 1, 1915. Lobectomy Second stage. The skin and muscle flaps were dissected upward. The ribs next above those previously resected were removed from angle to mammary line. The lower lobe was then freed from all adhesions including those to the parietes. The teriobar fissure was also opened, one or half of its extent. The operation was then brought to close by the introduction of the gauze packs with which the lobe was packed previously from all surfaces from which it had not been freed.

The postoperative amputation in this case as not occasioned by any unfavorable change in the patient's condition. Nevertheless considerable time had been consumed and the fear that any accidental blood loss during amputation might not be withstood resulted in the decision to close the operation.

The recovery from this stage was uninterrupted. The amount of sputum diminished only one third after two months of actual compression of the diseased lobe. Thus the pack which was renewed daily.

(This observation did much to destroy my faith



Fig. 1 Case 2 No. 125410 Cylindrical bronchiectasis. Excised lower lobe. Recovery.

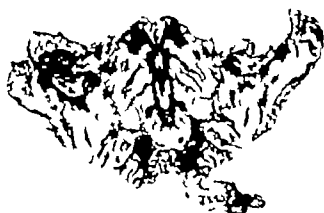


Fig. 2 Case 4 No. 12561 Cylindrical and saccular bronchiectasis. Excised lower lobe. Recovery.

in the curative effect of collapse therapy in advanced bronchiectasis.)

August 12 1915. Lobectomy amputation

The original field of operation was again freely exposed. No further rib resection was necessary to permit ready access to the lobe hilus which was clamped and ligated *en masse* with kangaroo tendon. After amputation of the lobe the separate arterial venous and bronchial branches were ligated with catgut distal to the mass ligature. The emptied portion of the pleural cavity was then packed with gauze and it was noted that the upper lobe was everywhere coherent to the parietes which fact precluded the possibility of any further concealed

pleural infection. Within one week the lobe strings sloughed away leaving two small fistulous openings. Within two weeks the cavity was clean and its walls granulating.

September 1915. The diaphragm has rapidly elevated itself. Shrinkage of all the cavity dimensions has occurred. The upper lobe has not contributed to the filling of the emptied pleural space. The wound is rapidly decreasing in size in all dimensions (Fig. 15).

January 1915. Patient has been at home three months. He has gained 30 pounds in weight. He has had neither sputum nor cough for four months. The wound is healed except at a small area in the new epithelium where two open bronchial fistulae persist. There is a very slight non-purulent discharge from these. These fistulae do not seem to concern the patient sufficiently to cause him to return for their repair.



Fig. 3 Case 3 No. 830 Cylindrical and saccular bronchiectasis. Autopsy specimen of entire left lung. Death followed drainage operation.



Fig. 4 Case 4 No. 1132408 Saccular (ampullary) bronchiectasis. Autopsy specimen of entire left lung. Death followed drainage operation.



Fig 5 N 14560. Severe bronchiectasis. Topographic specimen of right lung. Death followed drainage operation.

December 1906. Patient reports himself well and traveling with ease. He requests the ownership of the lung in a bottle that his demonstrations at the show may be even more profitable.

CASE 3. Chronic abscess of lung, bronchiectasis, pneumonia. Death resulted from encapsulated empyema. T 5 N 3076, male, age 23, janitor. Patient had had no illnesses previous to seven months before admission at which time tonsillectomy was performed under general anæsthesia three days after an acute attack of tonsillitis. The following night coughing commenced with expectoration and throwing up of blood. Such bloody sputum continued for one week. During the following three months blood disappeared from the purulent sputum, which continued in increasing quantities. For the past five months loss of strength persisted with profuse expectoration in the early morning. Vomiting to a half pint 24 hours. Sputum is generally brownish or gray.



Fig 6 N 60058. Cylindrical bronchiectasis following 3 year retention of a foreign body (acorn tooth, disengaged by arrow). Death followed drainage operation.

Upon admission to the Mayo Clinic the clinical diagnosis was abscess of the lung. The sputum was negative for tubercle and influenza bacilli. Pneumococci, micrococcus catarrhalis, diplococcus crassus.

Röntgenologists report. Marked increase in density over lower two thirds of left chest, probably old abscess in the anterior portion. Considerable retraction of pleura.

May 4, 1905. Exploratory thoracotomy. Four inches of the sixth seventh and eighth ribs resected in the region of the inferior angle of the scapula. Pleura opened. Lower lobe of lung found to be adherent to the diaphragm and to the posterior lateral pleura. Palpation of the lobe revealed no definite focus suggesting an abscess. It was assumed therefore that a chronic condition was present in which pneumonia had developed around abscesses or in association with bronchiectasis. The adhesions to the diaphragm were separated and the anterior border of the diaphragmatic surface of the lower lobe asutured to the upper border of the thoracotomy wound. A note dictated at the time of operation reads: thus exposing the under surface of the lower lobe.



Fig 7 No 15410 Roentgenogram Case 2 Unilateral (right) basal cylindrical bronchiectasis Type suitable for excision



Fig 8 No 154561 Roentgenogram Case 4 Unilateral basal cylindrical and saccular bronchiectasis Type suitable for excision

for later exploration with instrument or cautery Abscess left lung

A large gauze pack was placed in the lower pleural cavity. The wound was closed tight. Subsequently I concluded that the necessary procedure in this case would be excision of the lower lobe from which decision I must needs regard this preliminary operation as the first stage of lobectomy though it was not intended as such.

The day after operation the pulse rose to 120 from which point it fell gradually in the course of the following fifteen days. The temperature was 102 on the seventh day falling by lysis until the antemortem rise again to 102. The cough returned to its pre-operative state with the expectoration of green tenacious sputum. There was increasing loss of weight and strength. Finally dyspnea developed. The gauze packs were changed daily after the third day. Death occurred the fifteenth day.

*Autopsy findings* Moderate degree of cylindrical bronchiectasis. Large chronic abscess lower left lobe. In acute left encapsulated empyema not connecting with the operative wound. Acute purulent tuberculous pleuritis with effusion.

Death occurred in Case 3 from septicemia resulting from an unrecognized encapsulated

empyema occupying a portion of the pleural cavity which was picked with gauze at the operation but which was not packed in the subsequent dressings. It is conspicuous that this accident occurred in three out of the five cases herein reported. In two of these the encapsulated area was searched for and discovered thus saving the patients from similar deaths. *This untoward complication is emphasized as the most dangerous sequel to the several stage operation*—one nevertheless which if not avoided by careful picking may yet be overcome by detection and drainage.

**CASE 4** Saccular bronchiectasis of lower lobe and of basal portion of upper lobe (Figs 2 8 17) B L P No 154561 male age 20 clerk. Fourteen years previously patient inhaled one half a plum stone. Four months later developed severe cough. Six months later coughed up the plum stone. Since that time (13 years) cough and expectoration of purulent material have persisted. Frequent colds. Occasional night sweats. Sputum rarely blood streaked.

*Physical findings* A pale and anemic but fairly well nourished young adult. Fetid odor to breath



Fig 6 N 601 Right total bronchiectasis operable



Fig 7 N 69938 Bilateral bronchiectasis operable



Fig 8 N 24560 Roentgenogram Advanced bronchiectasis with thoracic cavity all obscured Same case Fig 5



Fig 9 N 603 Bilateral bronchiectasis operable



Fig. 1. Lower lobe excision in two stages. a. Crescentic incision. b. Stage 1: thoracic window made. Exposure of parietal pleura favors adhesion and anchorage of the upper lobe.

Relative dullness over entire left chest particularly at lower portion. Numerous loud squeaking rales at left base with areas of tubular breathing.

Leucocytosis 10,200. Urine negative. Roentgen finding. Marked thickening and cavitation left base. Thickened pleura at left base. Heart drawn to the left. Diagnosis bronchiectasis.

Operation left lobectomy 3 stages. April 16. First stage. Ether anesthesia. tracheobronchial aspiration. Seven inches of sixth, seventh and eighth ribs resected in the inferior scapular region. Pleura opened accidentally during rib resection. Pneumothorax produced in upper portion of pleural cavity. Lung seen to be adherent below but not palpated. Skin and muscle flap restored with silk

sutures. No pack. Patient cyanotic throughout operation from secretions in trachea.

April 8. Second stage. Tracheobronchial aspiration. Original flap raised and lengthened. Six inches of two ribs above wound resected. Pleura reopened high where lung was not adherent. Pneumothorax caused no symptoms. Lung adherent to diaphragm and lower costal pleura. All adhesions separated except those to adjacent lobe and to pericardium. Gruze pack placed to fill all vicinities over which skin and muscle flaps were sutured for tight closure. Profuse serous discharge leaking between wound stitches on the third day. Temperature normal pulse 120. Out of bed on fifth day.

May 16. Ether. Removal of pleural pack (two





Fig. 3. Lobectomy. Shrunken lung after removal of the upper lobe.

weeks after its introduction. Skin sutures kept up, pack presenting. Gauze for dressing with serum but not put in firmly adherent to pleural reflex. Lack renewed.

May 24. Either be on line of pleural pack. Jun. 10 to Aug. 4. Daily removal of pack to pleural space. It gradually reduced itself to size of a walnut.

August 5. 96. Third day of lobectomy. Original operation wound fully exposed necessitating removal of certain bands. Lower lobe rapidly delivered. Single large loop pleural lobe root. Mass silk ligature applied to original clamp and drawn taut as clamp removed. A small lobe bronchial branches ligated separately with catgut

silk. Large gauze pack placed in lower pleural space. The lower anterior portion of the upper lobe was noted to be of dark color resembling the bronchectatic lower lobe. It did not seem to be a fitting occasion for further lobectomy and it was judged that subsequent shrinkage might obliterate any process which might be present in the tongue of the upper lobe.

Bronchial leakage current throughout day of tamponade continued. Through this fistula purulent discharge is noted. There was complete absence of sputum except when a recumbent right lateral posture prevented fistulous drainage. Even then the sputum quantity never exceeded ten ounces in 24 hours.

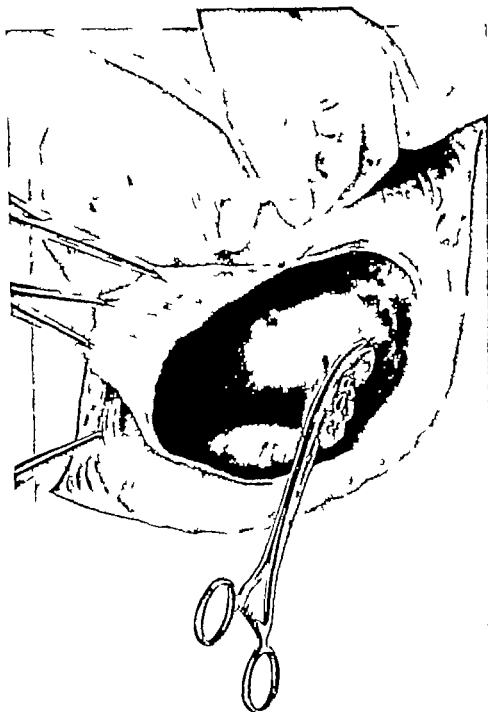


Fig. 4. Lower lobe excision. Stage (continued) amputation of lobe. Clamp to be substituted by mass ligature. Additional ligatures to vessels in stump. Two clamps may be applied and left in situ until ligature.

December 5, 1916. The patient has regained his weight — he is no longer anemic. The wound is healed except for a minute fistulous opening now surrounded by skin through which comes an offensive discharge. As long as this opening is patent there is absence of sputum. This man has now been advised to have a further resection of the diseased portion of the upper lobe in which disease is apparent in the roentgenogram. Comparison of this recent roentgenogram with that taken previous

to the first operation shows that the upper limit of the bronchiectatic cavitations has not changed proving that the upper lobe process was present in the beginning and has not since increased.

CASE 5. Saccular bronchiectasis (Fig. 3). G. T. No. 13830, male, age 26, brakeman. Influenza 8 years ago. Five years ago began coughing. Sputum not excessive and occasionally blood streaked. Sputum quantity gradually increased acquiring a foul odor until recently twice in a day he raised



Fig. 5 Case 4510 Lower lobe excised on operation  
 chu etts (Case 1) H 1 tal lobe excised 10 years after operation



Fig. 6 Case 4510 Lower lobe excised on operation  
 T month Pleural space not tested



Fig. 7 Case 5456 Lower lobe excised on operation  
 4510 Lower lobe excised on operation 10 months after last et obliter



Fig. 8 Case 5456 Lower lobe excised on operation 10 months after operation

half a cupful of yellowish fetid putrum with such force that it frequently discharged through the nose. No chills or fever but frequent colds.

Eight months previously a rib resection operation performed over lower left chest by a Toronto surgeon. No relief resulted. Clinical diagnosis bronchiectasis. Roentgen findings retraction of rib in costophrenic angle. Increased density resembling fluid. Bronchi apparently dilated. Case could be one of bronchiectasis.

Operation Left lobectomy. Two stage operation. October 9, 1916. First stage. Original scar operated upon by Toronto surgeon exposed by elevation of a crescentic flap. Ends of four ribs resected further to 2 inches anteriorly and posteriorly. Pleura opened 5 inches during the separation of old operative adhesions. Lower lobe seen adherent to diaphragm. Part of interlobar fissure found open. Latent markedly purulent during whole operation. Tube (Ways) good. Tracheobronchial aspiration not used. Skin and muscle flap sutured tightly in place.

Six days after operation difficulty in breathing developed together with sense of pressure in sub-sternal region. There was fever and leukocytosis. Opening of the wound permitted the escape of serum but the general sept condition was not altered. The fatal occurrence of an encapsulated empyema in Case 3 and the well nigh disastrous similar occurrence in Case 2 led to the suspicion that following the operative pneumothorax the lung had not entirely re-expanded that this unoccupied pleural space probably in the upper thorax had filled with fluid which being retained had become infected. A roentgenogram verified the suspicion showing clearly an encapsulated hydropneumothorax at a higher level than the now open wound.

October 3, 1916 under ether exploration for encapsulated fluid. Adhesions of left lower lobe to diaphragm separated without recovery of fluid. Lower lobe then separated from outer wall permitting the escape from above downward of a quart of thin semipurulent foul smelling fluid. A large gauze pack was introduced. The patient's condition promptly improved.

November 1, 1916. Second stage. Wound reopened. No further rib resection necessary. Parietal pleura now thickened 4 of 6 inches. Lower lobe now exposed at the level of the diaphragm. The lobe was freed from all attachments with more rapidity than in the previous cases. Unusual bleeding resulted the source of which was not discernible until a clamp was placed upon the lobe hilus at which moment all bleeding stopped exposing arteries in the lobe lacerated during its delivery. Four more clamps were applied to the root for security—the experiment being tried for the first time of trusting to the clamp crushing for hemostasis and for at least the usual degree of bronchial closure. Therefore no ligatures were applied. A large gauze pack was carefully placed it being noted meanwhile that the upper lobe had no parietal adhesions because of the unfortunate occurrence of the localized pneumohydrothorax following the first stage operation.

The clamp handles were tied together with silk. Seven days after operation two clamps were removed. Two days later the third. The upper lobe lay almost completely collapsed against the posterior wall. A slight bronchial leakage became apparent on the tenth day delivering a moderate amount of semipurulent secretion which has since gradually disappeared.

December 20, 1916. Patient discharged from the hospital. In two months following the lobe

amputation the patient has gradually regained strength though considerable septic absorption occurred during the cleaning up of the cavity from which sloughing fragments of visceral and parietal pleura have been thrown off. Today the entire cavity is clean the parietal surface being covered with pink granulations. The visceral pleura is thin and free from exudate. There is no cough or sputum by day. At night a reflex cough is probably occasioned by the passage of air through a minute fistulous opening which lies under the overhanging border of the collapsed upper lobe.

The temperature is normal and the pulse steadily falling as the patient's general condition improves.

Within a few weeks a decortication of the visceral pleura of the upper lobe will be performed in order to restore its function and if possible to obliterate the now much shrunken pleural space.

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## ENORMOUS HERNIAS

By WALTER R HEWITT M.D. St. Louis

UNDER this caption I have included only hernias of exceptional size and volume and presenting difficulties of the greatest magnitude. I am aware of the fact that smaller hernias especially of the umbilical or ventral types occurring in obese individuals frequently require the removal of a large area of skin and fat.

I do not propose to consider those hernias which are curable by removal of an abdominal tumor or cyst followed by secure and proper closure whether that be overlapping the layers transplanting fascia or muscle or the use of mechanical means or any combination of these.

You will therefore appreciate that these enormous hernia chiefly of the inguinal or

scrotal and rarely of the femoral or labial variety present a problem much more complicated in the technical details of the operations often exceedingly difficult of execution and with a very high mortality and morbidity as compared with the simple hernias.

In the class of hernias which we can designate as large or massive and below the enormous ones the estimated death rate has been placed at 6 per cent (McGlannan). However when strangulation or obstruction is added the mortality in massive hernias reaches nearly 50 per cent and therefore we should expect a proportionate increase in the case of the enormous type under similar conditions.

I propose to present two cases of enormous

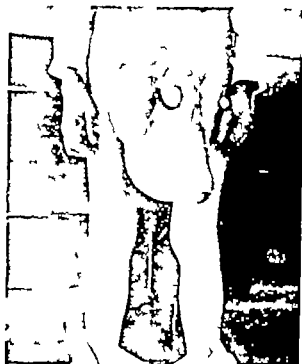


FIG. 1

the cecum and then resected making preferably an end to lateral anastomosis of the ileum and sigmoid by suture—an ileosigmoidostomy. Lane now advocates an end to end anastomosis.

The restricted operation of Moynihan should be performed when possible on account of the better end results.

Removal of a greater part of the omentum reduces the amount of mass to be returned and the consequential postoperative increase in tension. However the removal of a large mass of omentum may so damage (by embolism) the circulation of the stomach wall that ulceration and hemorrhage will follow and this must be borne in mind. The usual incision for hernia of the particular type is indicated though somewhat longer the contents are exposed reduced or resected and the sac removed along with redundant tissue ever remembering that the vitality of such tissue is usually low.

Some type of the Ferguson operation for inguinal hernia, Mayo for umbilical and Moschowitz for femoral are to be preferred.

The accidents subsequent to and after consequences following colectomy may be classified as those due to

- 1 Failure of the suture. This is most likely to occur in the presence of peritoneal infection. In this relation Chlumsky's observations are of much interest. He has shown that the union of intestinal wounds is firmer upon the first than upon the three following days; that from the fifth onward the strength steadily increases while at the seventh it should be thoroughly secure.

Local stitch abscesses are not likely to occur if the method of von Eiselsberg is used; the technique is perfect and the vascular supply is not greatly interfered with. This complication may occur with colectomy and the eighth or ninth day is that on which failure is prone to occur and therefore care should be exercised at this time in the use of enemata and purgatives.

- 2 Formation of adhesions is most frequent in the presence of infection and one must remember that there is a considerable denuded area with serum exudation and a fruitful soil for spreading infection and forming adhesions especially when there is a slow leak from the line of suture.

- 3 Shock due to loss of blood, anesthetic exposure of abdomen and handling of its contents has not been troublesome in any case and will be avoided by careful technique.

#### CASE REPORTS

**CASE 1.** No. 8634 City Inf. At G. H. Operation by Dr. Willard Bartlett at which I assisted and through whose courtesy I include the case. Patient age 72 white male laborer admitted to City Hospital October 7, 1900 with enormous bilateral inguinal hernia reaching to left side to about 10 inches above knee and the tip containing a hydrocele. On the right side the contents extended 10 inches and about 5 inches and were partially reducible.

A hernia had been present on the right side for the past 30 years and on left side for about 20 years. No history of trauma. Height 5 feet 6 inches. Weight 150 pounds. Gonorrhea at 44 years. Arteries sclerotic. Smokes cigars and drinks in moderation. Small amount of albumin in urine.

**Operation.** November 29, 1900 under ether anesthesia. Right hernia incision  $4\frac{1}{2}$  inches long; small intestine found in sac and returned to abdomen and

radical herniotomy with mattress iodized silk worm gut sutures performed. Left sac contained almost all of the large bowel extending from just above the sigmoid and including the cecum and about 3 inches of the ileum and reduction was impossible. Operation lower 3 to 4 inches ileum and ascending transverse and descending colon were removed and the ends were whipped over after Murphy button was inserted. Lateral anastomosis by Murphy button mesenteric vessels ligated and hernia repaired in usual way. Incision over scrotum hydrocele sac exposed incised and everted and the excess removed—several sutures at neck. Closure of scrotal skin by interrupted silk worm gut sutures.

Cecum was very hard and appendix was bound down in adhesions (chronic appendix).

*Postoperative course* December 6 1910 Wounds healed and patient convalescing. December 14 1910 Patient doing nicely and allowed to get up (16 days after operation).

*Note* X ray failed to show Murphy button yet patient did not know he passed it. December 17 1910 Stool normal 3 per day and feels well. Some induration about wound. February 23 1911 Sent to City Infirmary. Patient died November 30 1911 one year after operation of myocarditis and was turned over to Anatomical Board on December 1 1911.

The following case is interesting and gives a good idea of some of the difficulties encountered.

**CASE 2** Patient white female 51 years of age mother of eight children was seen by me April 19 1915 at her home in bed and she gave the following history. About 22 years ago and after she had had four children she developed a mass in the left groin about the size of a pigeon's egg this mass gradually grew larger and though formerly reducible had become irreducible. It had increased enormously in the past two years and she had gained considerable in weight now very obese. She blames the rupture on childbirth and claims that it became larger after each pregnancy.

Her mother suffered from a double hernia and a brother has a hernia.

She had suffered much pain frequent incarceration and lately had very numerous attacks of gastritis, relieved usually by morphine and bed rest. For some time she has been greatly incapacitated and spends much time in bed for relief of her symptoms and to avoid a dragging sensation. No bladder or rectal symptoms other than patient arising two or three times a night to void her urine. On the inner aspect of the mass there is quite an area of tenderness.

Examination reveals an enormous mass nearly as large as her thigh reaching nearly to knees tympanic on percussion giving an impulse on coughing and over which an occasional gurgling sound could be heard, and which was found to emerge from



Fig. 2 Case 2

beneath the left Poupart ligament. The left labra majora was stretched so as to partly form the inner wall. Urethral catheterization was impossible and specimen of urine not obtainable. The patient was rather stout and the fat hung in a broad fold about the lower abdomen (see Fig 2). Her skin showed the characteristic evidences of intestinal stasis and toxemia though the patient denied constipation. The heart and lungs were apparently normal.

*Operation* April 26 1916 After preliminary of morphine and atropine a 4 inch incision parallel to left Poupart's ligament was made and then lengthened as it curved downward over the center of mass and the sac exposed.

On opening the neck of the sac, I found a large pouch of peritoneum above Poupart's ligament and when traced downward it communicated with the enormous sac of the femoral hernia through a fist sized opening over which Poupart's ligament could be felt above symphysis and Gimbernat's ligaments internally and bone and muscle behind.

I then opened the sac below Poupart's ligament near its center and found it to contain the entire colon—(caecum ascending transverse and descending colon) all of the ileum and part of the jejunum as well as the entire omentum more or less cystic, and a small part of the stomach.

About one quart of serohemorrhagic fluid escaped on opening the sac the small bowel was distinctly cyanotic and had distinct plaques of fibrin over isolated areas the mesentery of the small bowel showed similar patches of fibrin and many

petechial hemorrhages this process was not so well marked on the colon and I called attention to the fact that the fat was so thick between the layers of the mesentery as to resemble lipomata though uniform in its distribution and rendering it very difficult and at times even impossible to distinguish between what was gut and what was fat. On passing the hand into the abdomen it was found to be practically full of fat and no abnormalities could be felt in the pelvis.

It was then evident that torsion of the mesentery had taken place at various times and was becoming more frequent as the intestines slid down into the sac made necessary by the increase in intra abdominal fat, large hernial opening and the consequent expulsion from their normal habitat. There were no evident bands of scar tissue in the mesentery and the attacks of so called *gastritis* were probably due to dragging on the mesentery and to a chronic partial occlusion due to an incomplete mesenteric twisting. Peristaltic waves were not visible and there seemed to be a loss of tone to the intestinal musculature as observed by Barker following obstructions. It was therefore evident that the contents of the sac could not be reduced partly or en masse and as evidences of torsion of the mesentery were plain I bore colectomy as a desperate effort to save the patient.

I began the resection in the ileum about 1 foot from the cecum then mobilized the cecum and continued the resection to include the ascending transverse and descending colon. The mesentery contained so much fat that only a very small part could be included in the clamps and as the fat fused with the intestine one had to be very guarded and careful to avoid opening the bowel. The mesentery was ligated in clamp sections.

I then closed over the stumps of both ends of the intestine after the method of von Eschberg (France) and then performed ileocolicostomy by the lateral method.

Still the mass was far too large to permit of any thing like reduction so I removed practically all of the great omentum. Then after doing this reduction could not be effected.

I then had the patient put in extreme Trendelenburg position and under deep ether narcosis succeeded in effecting a reduction. Having observed considerable blood and serum in an abdomen following such extensive operations I established dependent drainage through the left loin with a rubber tube.

Careful examination after reduction revealed an opening in Poupert's ligament the size of the fat with femoral vein to the outside. Gimbernat and Cooper's ligament internally the pectineus and bone posteriorly.

The sac was then found to be about the size of a two gallon pail and Poupert's ligament presented a vertical serrated tear which probably increased with each successive labo due to an increase in the cubic contents of the hernia. I ligated the sac

beneath Poupert's ligament with an internal purse string suture and removed the redundant sac and skin at the same time fashioning out skin flaps to cover the inner aspect of the groin and preserve a sort of labia.

Closure of the opening in Poupert's ligament was effected by suturing the ligament to the underlying muscle by interrupted mattress sutures of No. 2 to day chromic catgut. Skin was closed with interrupted silkworm gut sutures and Michel clips. One rubber and one cigarette drain was inserted through a dependent stab wound near the left thigh.

The patient was then gradually returned to the horizontal position. I then hastily performed a Ferguson operation to cover the defect above Poupert's ligament and the skin was closed with interrupted silk worm gut sutures and clips.

The patient's stomach was washed while she was on the table and the dressing being applied. She was returned to bed with a pulse of 104 placed in moderate Fowler position and continuous proctodynia started.

*Postoperative course.* The next day April 2 she complained of headache became delirious breath unpoisoned and there was a twenty four hour output of less than 4 ounces of urine brownish in color loaded with albumin and containing many finely and coarsely granular casts. Her pulse became irregular in volume and rhythm and her blood pressure which prior to the operation was 90 millimeters of mercury rose to 30 millimeters.

The tongue was dry and coated and at 5:00 p.m. on April 27 30 hours after operation she was suffering from an alarming anuria due to uremia. I then forced her to take by mouth water in moderation lemonade (without sugar) potassium acetate lemonade 5 grains to each glass of water taken in 1 ounce drinks and digitalin 1/50 grain at four intervals. In addition she received 650 cubic centimeters saline by hypodermoclysis within 4 hours and absorbed it well. At about this time she began to retain for the first time the proctodynia 20 drops per minute and during the second night took a pint and a half. Her urinary output arose and showed 11 ounces in 12 hours pulse improved and she stood thus. Pulse 30 respiration 26 temperature 99.6 in axilla blood pressure 14 millimeters tongue moist and mucous breath had disappeared. Mentality clear began her second postoperative day.

*Second postoperative day.* Urine clearing up. Wound dressed and left flank drain removed. The groin dressing was saturated with sero-hemorrhagic discharge drains shortened wound margins rather dusky colored and there was moderate swelling abdomen not distended. Salt solution enema yielded few particles of fecal matter and much flatus and thereafter patient became comfortable and she perspired freely.

*Fourth postoperative day.* Pulse 96 respiration 26 temperature 98.4 considerable sero-hemorrhagic discharge with urinary output now about 60

ounces in 24 hours Patient saturated dressing with urine and feces several times necessitating change of dressings Bowels moved well of own accord

*Sixth postoperative day* Pulse respiration and temperature now normal Clips and stitches all removed Some aloughung about stab groin drainage wound and in groin opened and packed open with gauze Patient put on broths peptonized milk and custard, etc Bowels move every day and are under patient's control now

*Eighth postoperative day* Infection of groin clearing up and evidently bacilli coli infection from involuntary control of excretions

*May 10 1915 thirteenth postoperative day* Urinary output has fallen to 15 ounces in 24 hours Tongue coated and pulse has risen to 132 respiration 28 temperature 100.4 Bowels move 2 or 3 times per day now and patient has returned to involuntary action of bowels and urine Some dyspnoea wounds doing well Patient was formerly taking diuretic 10 grains four times per day and water abundantly and so I returned to the same treatment adding digitalis Patient insistent about getting up in chair

*Fifteenth postoperative day* Pulse continues rapid along with threatened suppression of urine and hematuria — output now about 15 ounces and containing large amount of albumin many hyaline and finely granular casts many red cells and few leucocytes — patient irritable and restless and involuntary passage of feces and urine continuing — pulse at times weak and thready

Wounds clearing up nicely Patient put up in chair for 30 minutes after which she returned to bed and slept well Sweats produced twice daily

*Seventeenth postoperative day* Pulse 124, respiration 30 temperature 99.8° tongue dry and coated Blood pressure has risen to 144 millimeters Patient stuporous Has voided only 2 ounces of urine in last 7 hours even with a pint and a half of saline per rectum Hypodermoclysis 375 cubic centimeters sweats diuretic, calomel digitalin and potassium acetate continued

*Eighteenth postoperative day* Pulse rose to 160 One eighth grain pilocarpine (hypo) brought about free perspiration and bowels moved well with two drams Rochelle's salts Wounds healing nicely in spite of frequent saturation with urine and feces Epsom's salts 20 cubic centimeters and strychnin 1/30 grain three times during the day Liquids and water abundantly by mouth

*Twenty first postoperative day* Patient up for three hours on porch in chair Pulse 112 respiration 24 temperature 97.8° bowels moving 3 to 4 times a day Urinary output increasing in spite of very cool weather

*Twenty fourth postoperative day* Patient all smiles unnaion and defecation voluntary

*Twenty sixth postoperative day* Urine shows trace of albumin occasional cast and a good many leucocytes and some epithelium and is again clear and of normal color Patient walked for first time and went home in auto this evening Wounds practically well Returning home she continued nervous and had 3 to 4 bowel movements a day

*Thirty sixth postoperative day* Patient was found in room of saturated unnaous atmosphere in uræmia from which she died in a few minutes

Her wounds had almost healed and I regret that I was unable to obtain a photograph as I had hoped to show the result when they were healed

## EXOSTOSES OF THE ORBIT

### WITH CASE REPORT<sup>1</sup>

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THE theme of orbital exostoses has received very little attention in either surgical or ophthalmological writings in recent years

Some valuable contributions may be found however in the older literature in any of the great systems of the eye for instance one edited by Norris and Oliver Bull's article the *Graefes Saemische Handbuch der Gesamtem Augenheilkunde* and the second volume of the *Traite des tumeurs de l'oeil et de l'orbite et*

*des annexes* by Lagrange A valuable paper may be found, by J. A. Andrews on 'Osteomata of Orbit' in the *Medical Record* of September 3 1887

The history of a case of unusual interest follows

Male age 26 farmer referred by Doctor Rusk of Cadiz Ohio Family history negative, no previous morbid personal history

Fifteen years ago without apparent cause there was noticed a small hard lump within the right orbit, on the nasal side The hard bony mass





Fig. 1. Frontal view of the orbit.

developing in the direction of least resistance soon encroached upon the orbit, but many years passed before it became either unsightly or dangerous. It was only a few months before admission that its pressure seemed to impair the integrity of the eye with a blurring vision, mild diplopia and pain.

The patient entered the Ohio Valley General Hospital, an athletic young man, normal in every particular except the right orbital tumor for which he came for treatment.

A hard rounded bony tumor about the size of an English walnut protruded from the nasal side of the right orbit. The surface or outer crust of the mass presented several rounded openings the size of the head of a pin, leading to the interior of a less resisting material. The mass had by years of pressure and erosion pushed its way through and beyond the upper lid and had crowded the eye with unyielding force to the outer orbital wall and protruded well beyond the orbital margin.

**Operation.** January 6, 1906 ether narcosis.

In attempting to remove the exostosis some difficulty was experienced in locating the point of origin or base of the mass, but after dissecting loose the encapsulating periosteal sheath which surrounded the proximal two thirds of the growth its origin could be traced in the direction of the ethmoid bone.

By a process of prying or leverage and well directed to and fro force with the aid of a strong vessel

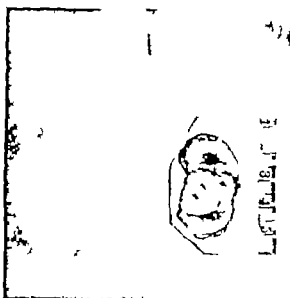


Fig. 2. Tumor removed from patient. Note the charred exterior and rounded opening leading to less resisting portion beneath.

lum forceps the pedicle was broken through at its point of attachment and the tumor removed.

It has been suggested that in the scapula growths of a bony like lameness holes may be drilled by means of dental engine and the operation subsequently completed by means of the chisel and mallet, but this procedure was not necessary in the removal of the tumor as composed of a much less dense material than the bone of the orbit.

The bleeding at first was profuse filling the nose, pharynx and mouth probably due to the rupture of the gorgel veins, the limous and periosteal structures. This was soon arrested by tamponade.

The ungual plate of the index finger could be easily carried into the space corresponding to the orbital plate of the ethmoid and within the large cavity the broad rough base could be appreciated from which the pedicle had been freed.

#### CLASSIFICATION AND ORIGIN

While orbital osteophytes, periosteoses by periosteoses or exostoses have all been (1) classified together for the sake of convenience, what are commonly known as exostoses are very hard tumors having an ivory like shell so hard are they at times that the usual bone cutting instrumentation makes but little impression upon them (exostosis eburnea). De Schweinitz (2) has described the condition beneath this hard exterior in some of them is made up of a spongy bone.

the tumor may be of a cartilaginous consistency. The non malignant orbital exostoses like a sarcoma, may originate from inflammatory exudates from the periosteum but unlike the malignant growth their development is very slow or they may grow immediately from the diploe of the bone. In the latter case they are likely to extend at the same time into the orbit and into one of the neighboring cavities (3). In the case here reported the tumor was fifteen years attaining the size of an English walnut.

In those cases in which an orbital exostosis pushes its way beneath the lid one can well understand that its removal becomes a much more difficult procedure than the variety here described where through pressure necrosis the tumor has become extrapalpebral.

#### ETIOLOGY

It has been suggested that we may look for the cause in an abnormal embryonic condition of the bone cells. They may be congenital or develop as a result of trauma. Syphilis which might be thought a frequent cause is a rare or even doubtful factor.

#### SYMPTOMS

Exostoses give no pain on manipulation when percussed with a metal instrument they yield a note similar to striking bone or stone.

Any symptoms referable to the eye such as visual disturbances optic nerve changes hyperemia or papillitis would naturally arise from degrees of pressure and as Bull has pointed out encroachment upon the cavity of the skull and its contents may result in gradually increasing cerebral symptoms.

#### OPERATIVE COMMENT

The hemispheroidal shape and sessile attachment usually observed in these tumors often make their removal most difficult. It may be imperatively necessary early in the operation to determine the point of attachment of the tumor for to ruthlessly chisel or drill through the densely resisting pedicle with the brain in dangerous proximity surrounded as it is with infective material would make the operation an extra hazardous performance.

Berlin (4) has collected thirty two cases in which extirpation of orbital osteomata



Fig 4 Patient ten days after removal of exostosis

has been performed. Of this number eight died 25 per cent. In the sixteen cases of this series in which the growth was situated in the roof of the orbit six died thus giving a mortality of 38 per cent. The cause of death in these cases was a meningitis encephalitis, and abscess. This writer advises the greatest conservatism when the growth occupies the orbital plate of the frontal bone.

Fuchs (5) of Vienna has suggested when the eye has been pushed out of the orbit by a large osteoma and has already caused blindness it is sometimes better to relieve the patient of his troubles by enucleating the eye rather than to expose him to the dangers of an extirpation of the growth.

The eyeball must be carefully guarded when leverage is attempted in the extirpation and precautions must also be directed toward preserving the pulley of the superior oblique tendon of the obicularis and levator palpebre muscles. Again the integrity of the infra orbital nerves and the lachrymal gland must not be compromised.

A few cases of exostoses have been reported (6) in which a cure resulted from necrosis and spontaneous separation.

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## ECTOPIC PREGNANCY

## A REPORT OF 106 CASES

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IT is the purpose of the writer to present for review the results obtained from observation of 106 cases of ectopic gestation. The reasons for this paper are threefold: (1) to see whether or not among these cases some new facts of interest may be discovered; (2) to find out how near the clinical picture of these cases accords with the findings of others; (3) to emphasize certain features of the disease which seem to the writer particularly important in the light of our present knowledge of ectopic gestation.

The cases extend over a period of years and all have been under my personal observation in private practice and while on service at the Lincoln, German and Sloane Hospitals. Many of the conclusions as will be seen are not based on all of the 106 cases, for unfortunately some of the histories are incomplete or the necessary data could not be obtained. When such is the case a statement to that effect will be made.

## ETIOLOGY

The causes of ectopic gestation, both actual and theoretical, as obtained from a review of the literature may be arranged in the following manner:

Diseases (a) of the tube proper causing loss of elasticity and cervical contraction of the tube:

- Salpingitis—simple, purulent and tubercular
- Torsion of the tube wall

3. Cervicoabdominal fistula after hysterectomy (Koeberlé)

Diseases (b) outside of the tube causing pressure on the tube:

- Fibroids
- Cysts

1. Peritoneal bands and adhesions

Tumors—polyp of the tube

Congenital defects:

- 1. Maldevelopment
- 2. Decidual reaction of uterus (Webster)
- 3. Diaphragm

I. In this series of cases the following conditions bearing on the etiology were found:

Previous implant or suppurative condition of the	
uterus, ovaries and tubes	20
History of Bartholin's abscess	
Previous ectopic gestation	5
Fibroid tumors of the uterus	
Ovarian cyst	3
Appendicitis	
Operation for prolapse and internal hernia	
Total	33

Of the other 72 cases no cause could be obtained. There were no congenital defects reported from the laboratory. The macroscopical appearance of the tube on the other side was normal.

II. Age. The age of these patients ranged from 19 to 43 years. The average age was 29½ years. The disease in 50 cases occurred before 30 years of age; 28 cases before 25 years; 22 cases above 35 years.

III. Time of occurrence of the disease from the date of marriage in 72 cases. The earliest was 1½ months with no history of infection and the latest 18 years without history of previous infection. Sixteen cases occurred about five years from marriage; 18 about 8 years; 12 about 15 years and 26 within the first two years of married life. No reports were obtainable in 34 cases.

IV. Time of occurrence of the disease from the last pregnancy:

Within eight months of previous pregnancy	7
Within 1 to 3 years or less of previous pregnancy	43
About 5 years from previous pregnancy	10
Total	60

Forty-five cases out of 85 followed labor at term; 40 followed miscarriages. Nine patients had not been pregnant before the ectopic pregnancy occurring at intervals of 6 weeks to 10 years: (1) 4 cases between 5 and 11 years; (2) 3 cases between 1 and 2 years; (3) 2 cases between 6 weeks and 3 months.

V. Menstrual history in 96 cases

Normal (28 days 3 to 4 days duration)	51
Profuse	30
Scant	6
Irregular (delayed in 5 short in 3)	9
Total	96

A history of dysmenorrhœa was obtained in 47 cases

VI *Recurrence of ectopic pregnancy* occurred in five patients

*Conclusions* On the basis for the supposed causes of tubal pregnancy a cause for the abnormality was present in about one third of the cases. Of the other two thirds no cause was ascertainable. The age the marriage period, the relation in point of time to previous normal pregnancy or miscarriage and previous sterility appeared to have no particular bearing on the etiology. One case occurred while the mother was nursing her child and had not menstruated from the time of her delivery. The recurrence of ectopic pregnancy might possibly have some bearing on Webster's hypothesis especially as one of these cases occurred in the stump of the tube that had been the seat of previous ectopic pregnancy

#### PATHOLOGY

1 Site of the disease in 100 cases	
Right	
Left	54
Double	46
2 Site in the tube in 96 cases	
Inner half	38
Outer half	32
Interstitial	3
Ovarian	2
Not obtainable	32
3 Termination of pregnancy	
Tubal abortion	
Unruptured (living)	55
Tubal mole	6
Erosion of tube	5
Rupture of tube	21
Abscess with fetus	4
Condition not determined	1
4 Occurrence	
Single in	103
Double in	3
Associated with normal pregnancy	1

In one case the ectopic occurred twice on the same side—in the stump of the former tube

5 Duration of pregnancy	
Youngest	about 3 weeks
Oldest	about 3 months
Average	about 6 weeks

*Conclusions* The pathological conditions found lead to the following conclusions

1 That ectopic pregnancy occurs about as often on one side as the other. If previous inflammatory condition of the tubes were the sole cause we would expect the condition to be more prevalent on the left side

2 That the pregnancy is located about as frequently in the inner half of the tube as the outer that interstitial and ovarian pregnancies are of rare occurrence

3 That tubal abortion is the variety of rupture most commonly found whereas of the other varieties erosion of the tube is very much more common than rupture from overdistention. Severe hemorrhage may occur from tubal abortion and erosion of the tube. It is uncommon for the ovarian artery to be eroded. Rupture into the broad ligament is conspicuous by its absence

4 That double ectopic pregnancy is very uncommon that ectopic may be associated with normal pregnancy that interstitial ectopic may push its way into the uterus and continue to grow that it is possible for ectopic pregnancy to occur twice on the same side

5 That the termination of ectopic pregnancy usually occurs in about six weeks pregnancies later than three months being uncommon

6 That most ectopic pregnancies die (a) and are discharged into the abdominal cavity and absorbed (b) they become a tubal mole and are absorbed (c) the fetus disintegrates and forms an abscess in the abdominal cavity

#### SYMPTOMATOLOGY

A *Pain* Two general varieties of ectopic gestation are recognized clinically (1) The acute violent form with excessive hemorrhage and shock (2) The subacute form with one or more minor attacks of acute pain lasting over a considerable period in the intervals between which the patient may feel fairly well or be disturbed by dull pain or abdominal tenderness. Hemorrhage from the uterus may be continuous or intermittent. In this series of 106 cases 15 were of the first type and 91 of the latter

The character of the pain in 88 cases was intermittent and cramp like in 62 dull continuous in 15 sharp continuous in 8 and pain was slight in 3 cases. History of sudden collapse falling to the floor or being carried to the bed occurred in 6 cases. Out of 106 cases there were single attacks of pain in 26 cases two attacks in 16 cases and several attacks in 64 cases. Uterine bleeding was closely associated with all attacks of pain in all cases but 11. In these the flow began some considerable time after the pain. Pain came first in 13 cases bleeding first in 19 and both together in 23 cases out of a total of 55 cases. Pain was referred generally to one or the other side of the abdomen depending upon the site of the lesion. In 3 cases however both sides were equally painful and in two the pain was referred distinctly to the healthy side.

#### B Menstrual history in 95 cases

A. Interruption of the normal menstrual flow  
On per. od. skipped in 50 cases  
Two per. od. skipped in 4 cases  
Five per. od. skipped in 1 case

Uterine haemorrhage was absent in two patients and bleeding continued intermittently for five months in two patients. The average duration of bleeding was about 18 days was intermittent in a majority of the patients but continuous in a great many.

C Temperature in 106 cases. Lowest 97 F highest 103 F. The average morning temperature was 98.8° F the average evening temperature was 100.1 F (mouth). Few cases ran a normal temperature throughout the 24 hours.

D Pulse in 106 cases. The range was from 62 to imperceptible the average morning pulse being 78 evening 104.

L Blood count. The examination of the blood taken as a whole was not satisfactory as an aid to diagnosis. A chart of 27 cases selected at random will show how difficult it is to draw any conclusions of value.

Eighty two per cent of the cases showed some diminution in the number of red cells 70 per cent showed increased leucocytosis with corresponding increase in the polymorphonuclear cells. It seemed possible to gather from observation of these blood

BLOOD-COUNT CHART

Red cell	Hæmoglobin	White cells	Polymorphonuclear cells	Pulse	Temperature F
1,800,000	6	600	87	30	97.5
700,000	60	000	88	00	97.6
3,000,000	1	3,000	93	3	99.0
000,000	40	8,000	84	Imperceptible	99.0
4,400,000	8	8,000	80	98	98.4
4,200,000	78	8,000	65	120	00
4,500,000	80	1,000	74	80	99.6
4,000,000	80	1,000	84	1	02
3,500,000	7	17,000	80	76	99
4,500,000	8	8,000	76	88	99
700,000	35	9,300	77	104	03
3,000,000		000	76	9	98
4,800,000	83	8,000	6	98	00
3,500,000	7	7,000	80	00	00
4,200,000	80	000	6	7	99.4
4,500,000	8	000	80	8	1
1,700,000	9	10,000	83	30	03
1,400,000	60	36,000	88	33	97.5
800,000	00	4,500	79	1	99
4,000,000	60	0,000	80	98	99.6
3,200,000	38	000	94	35	1.3
4,000,000	6	6,000	87	00	00.6
4,00,000	8	000	80	1	
700,000	18	000	83	74	01
4,500,000	83	6,600	76	80	99.6
4,200,000	8	200	80	04	99.6
600,000	30	000	9	50	98.6

counts one particular fact that as the number of red cells decreased the white cells showed a corresponding increase both in number and polymorphonuclear cells. Where there was an associated rise of temperature of any moment the leucocytosis and polymorphonuclear cells appeared to increase in greater proportion. In many severe cases the noticeable symptoms noted were a considerable rise in temperature rapid pulse low red cell count high white cell and polymorphonuclear increase. This sequence unfortunately did not always follow and as has been mentioned the blood picture in many cases was disappointing and confusing.

F Urine. The examination of the urine of 106 cases revealed a fact of some considerable interest possibly of some importance. Thirty eight cases showed anywhere from a trace to a small percentage of albumin and associated with this hyaline and granular casts. This evidence of possible degenerative change in the kidney must point to the excretion of some deleterious material for it occurred too often to be merely a coincidence.

Symptoms such as morning nausea increased size of breasts with tenderness could

not be obtained with any degree of satisfaction. Irritability of the bladder occurred in 40 cases of the rectum in 22 cases out of 106.

In 86 cases rigidity of the abdomen occurred 51 times. Distention was present in 66 cases out of 106. Tenderness over the site of the disease was present in all cases. This tenderness was exquisite and entirely out of proportion to the amount of rigidity and distention of the abdomen. This was particularly noticeable on bimanual examination and again where traction was made on the cervix. Out of 106 cases examined a mass was felt in 85 cases bimanually. Some enlargement of the uterus could be determined in about half the cases and the cervix was reported softened in 78 cases out of 106. One feature of diagnostic interest was the position of the uterus. Out of 106 cases examined the uterus was forward in 87 cases and retroverted or flexed in 19.

*Conclusions from physical examination.* In the differential diagnosis between ectopic pregnancy and inflammatory conditions of the tube or appendix the symptoms of rigidity and distention are of no particular value. Two features however seem to be of some value. (1) The peculiar exquisite tenderness of one or the other side of the pelvis determined by bimanual examination out of all proportion to the rigidity and distention of the abdomen. (2) The forward position of the uterus. In inflammatory conditions adhesions formed tend to pull back the uterus in retroposition whereas in ectopic the pathological condition does not exist long enough to cause this condition. Where there has been a previous inflammatory condition the position of the uterus is of course of no assistance. The peculiar doughy feeling of the pelvic mass is valuable as a diagnostic sign but unfortunately it is not present as often as one would expect and a cecum or sigmoid distended with soft feces will often give a similar sensation. A softened cervix simply means congestion and the enlarged uterus is not easy to determine in early cases.

*Conclusions on symptomatology as a whole.* A review of the facts leads to the following. Ectopic pregnancy is for the most part rather

a subacute disease a disease in which the symptoms continue with one or more exacerbations for one or more weeks the patient gradually becoming weaker and weaker until relieved by operation or death of the pregnancy. The so called acute cases violent cases are very much in the minority. Therefore we must think of ectopic pregnancy as a disease comparable to a more or less severe type of salpingitis many of the symptoms of which it has.

1 The pain of ectopic pregnancy is of importance very much like the cramps of intestinal colic it is often taken for such. Not all cases have pain of a cramp like character however. Very often associated with these cramps is a feeling of faintness vomiting chilly sensations and constipation misleading the physician in the direction of intestinal disturbance.

2 The classic feature of a skipped period is absent in a majority of cases. This fact is of importance as a warning not to place too much faith in the symptom as a necessary concomitant of the symptom complex of ectopic pregnancy. One feature of the menstrual epoch is present with considerable regularity—irregular spotting or severe bleeding continuous with menstruation or during the intermenstrual period. The color or the consistence of the blood is of no diagnostic value. Irregular bleeding so often accompanies uterine inflammation however that it is in itself not diagnostic.

3 Ectopic pregnancy is not a disease of normal temperature. Some temperature is present in almost every case with a range between 99.5° F and 100.5° F.

4 Pulse rate and blood pressure are of little diagnostic importance except in those cases where the frequency of the pulse is out of proportion to the temperature.

5 The blood picture is not satisfactory. Leucocytosis is present in a large proportion of the cases and a low red count is generally accompanied by a high white but this does not occur regularly and the results are often confused.

6 The presence of albumin and casts in the urine in a large percentage of cases is significant.

7 Irritation of bladder and rectum is much more common than is generally supposed.

8 The physical examination abdominal and bimanual reveals the usual signs of peritoneal irritation tenderness distention and rigidity—more or less pronounced and the bimanual examination often discloses a mass in the pelvis. These symptoms however are present in salpingitis. There are certain symptoms nevertheless which seem to be of special value (1) exquisite tenderness out of proportion to other local symptoms (2) the situation of the uterus in the normal position movable and not in retro position fixed (3) the boggy sensation to the mass in some cases (4) the enlarged uterus and soft cervix (5) rarely the blue vagina. In many patients however there is nothing but exquisite localized tenderness to guide us in our diagnosis.

#### DIAGNOSIS

The analysis of 106 cases of tubal pregnancy leads to the conclusion that there is no one diagnostic symptom peculiar to the condition. The symptom complex however if complete affords an easy diagnosis. If the patient who has had previous pelvic trouble and has passed two weeks over her period is suddenly seized with cramps in the lower abdomen which are localized to one side if the patient begins to flow feels weak and vomits if she has a temperature of about 100 F with pulse of 120 and she goes to bed and after a few hours is relieved and in two or three days is able to be up and around only to have the attacks repeated once or perhaps several times and if examination reveals a pale woman with some local distention and rigidity of the abdomen with peculiar exquisite tenderness to one side of the uterus on bimanual examination the presence of a boggy or elastic mass the uterus enlarged and in position the cervix soft vagina blue then the diagnosis should be made without any difficulty. Unfortunately these symptoms are not often assembled in such a satisfactory manner and the diagnosis is then very difficult. Only too often the uterus is curetted for a supposed

abortion or the patient is treated for salpingitis or appendicitis. There should be no difficulty in diagnosing the acute variety of ectopic pregnancy. Out of 106 cases 6 were diagnosed before rupture 70 after in 30 the diagnosis was improperly made.

#### PROGNOSIS

Out of 106 cases 7 died. Five belonged to the acute type 1 died while being prepared for operation 2 without operation 3 following operation and 1 suddenly thirteen days following operation in apparently good health from pulmonary embolism. The mortality is therefore low and with proper care the patients generally recover.

#### TREATMENT

It is not the purpose of the writer to discuss the various methods of treatment of tubal pregnancy. Of this series of cases all with but four exceptions were operated on as soon as the diagnosis was made. Of the 4 cases excepted 2 were in such acute shock from loss of blood that it was deemed advisable to wait in the hope that the patients might react from the initial shock the other died before the abdomen was opened.

#### CONCLUSIONS

The conclusions reached from observation of these cases would seem to be that all subacute ectopic pregnancies should be operated on at once removing from the abdomen the tube affected the fetus placenta membranes and blood. All acute cases should be operated on at once except cases in *extremis*. In these cases it would seem advisable to wait watching the patient very carefully. If no improvement occurs in a very short time operate. Two cases of this series bled to death. The ovarian artery had ruptured in both. One was an interstitial pregnancy. As there is no doubt therefore that patients can bleed to death operation must not be delayed too long in waiting for a reaction in these extreme cases. The abdominal route was chosen in all these cases and it is undoubtedly the only safe procedure to follow. Inasmuch as there were no cases extending to the viability of the child in the series there will be no discussion of the treatment in this condition.

# DEPARTMENT OF TECHNIQUE

## THE TECHNIQUE OF THYROID OPERATIONS WITH LOCAL ANÆSTHESIA, SCOPOLAMINE AND MORPHIA

By FRANK H. LAHEY, M.D., F.A.C.S., BOSTON

Assistant Surgeon, Boston City Hospital

IN the *Boston Medical and Surgical Journal* for October 15, 1914, the writer published his experiences with local anesthesia in thyroid surgery. Twelve cases were reported, the last three of which had received scopolamine and morphia. At that time he ventured the prophecy that scopolamine and morphia would supply the mental quietude so necessary for the success of local anesthesia in thyroid surgery.

After a more extensive use of this method the writer is able to say that the method which he has developed and employed in this series of cases has been everything that he expected of it except in the instances noted, and has in his hands made thyroid surgery easier, safer and less worrisome.

The method has now been sufficiently tried out and standardized by the writer to justify him in describing it and drawing a few, not too far reaching conclusions from his experience with it.

### DESCRIPTION OF METHOD

Two days previous to the day of operation a cathartic is given the patient, none being given the day before operation in order that the night before operation shall not be disturbed.

On the afternoon before the day of operation the patient is seen and told of the necessity of co-operation on her or his part. She is told that apprehension and lack of confidence are two of the most constant causes of the failure of scopolamine and morphia to produce their proper effect. She has impressed upon her the fact that the success of the procedure depends upon what her attitude toward it will be, and is in fact, almost entirely in her hands. All possible effort is made to win the confidence of the patient in the method. She is assured that if she is hurt or becomes unduly restless she will be given a general anæsthetic. It has also been the writer's custom to tell his gayer patients who have already been operated upon and are still in the

hospital, to visit new patients and honestly relate their experiences to them.

With increasing practice in judging these cases, the writer finds himself able in most instances to decide with considerable exactness what the success of the method is going to be with the different individuals.

On the night previous to the operation, ten grains of veronal are administered at eight o'clock.

On the morning of the operation, two hours previous to the hour when it is intended to start the operation, which is at as early an hour as possible, one two hundredth of a grain of scopolamine with one sixth to one quarter of a grain of morphia, according to the size and age of the patient, are administered hypodermatically.

One hour later provided the respirations are not stertorous, the pulse irregular or the patient excitable—conditions which have never appeared in the writer's experience—another two hundredth of scopolamine and another sixth or fourth of morphia are administered.

After another interval of an hour at the time set for operation the patient is visited, and if found sleeping is transferred to the operating room as quietly as possible. If the patient is not sufficiently drowsy as shown by her remaining awake after being aroused, she is given another dose of one four hundredth of scopolamine with no morphia.

After the patient has arrived in the operating room all efforts are directed toward the prevention of noises and jars that would even temporarily awaken her. She is placed on the table so that the neck is on the stretch and so that no other shifts in position will be necessary.

The neck is lightly washed, wiped over with alcohol, and draped with towels and sheets. Iodine is not used because it obscures the wheels in the skin which show the proper points for the introduction of the local anæsthetic.

An ounce of approximately 2 per cent novoc-





Fig. 1. The infiltrated line of incision and the method of injecting into the skin by holding the skin between the thumb and forefinger.

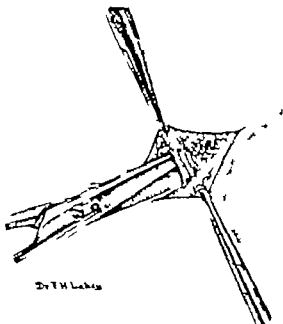


Fig. 2. Showing the method of freeing the platysma subcutaneous fat and skin from the underlying muscles.

caine solution is now freshly prepared by adding two-four grain novocaine tablets to an ounce of salt solution or sterile water. To this I added fifteen minims of fresh adrenalin solution. The writer fully realizes the strength of this solution

but has had no ill effects from its use and feels sure that the results with weaker solutions have on the whole been less satisfactory. With this solution it is unnecessary to wait at all before starting the incision. The entire ounce of a per cent novocaine solution may be used with safety.

The first injection is made in the middle of the neck at the point which will correspond to the center of the collar or U shaped incision. Care is taken to inject the solution into the skin and not into the cellular tissue beneath it. This may be accomplished by picking up the skin of the neck which is very loose between the thumb and forefinger as shown in Fig. 1 so that one is enabled not only to hold the skin taut but to feel plainly the tense, hard swelling produced in the skin by the injection as it bulges the skin out between the fixing and palpating fingers.

It is essential that a fine hypodermic needle be used as with a coarse needle it is almost impossible to make the injection directly into the skin a large portion of the fluid escaping into the cellular tissue beneath.

The injections are continued from the center outward to one end of the proposed incision and then starting from the center again outward to the opposite end producing the appearance shown in Fig. 1. The ascending limbs of the proposed incision should be injected considerably

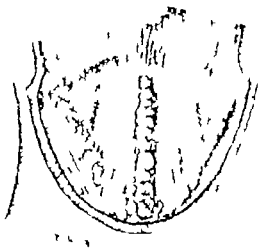


Fig. 3. Showing the flap turned up and the muscles covering the gland exposed and the incisions along the anterior border of the sternomastoid and the median line. Dotted line shows where clamps are to be applied. Arrows will be necessary to inject here.

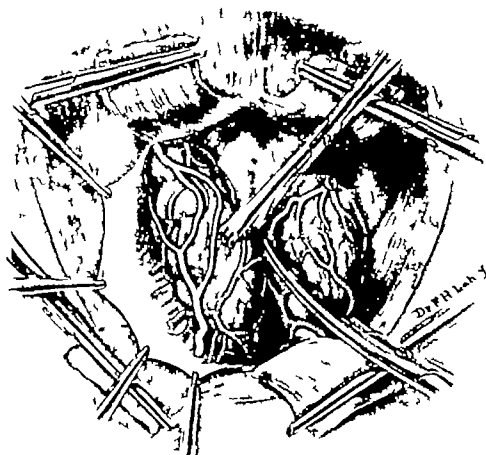


Fig. 4. Showing the gland exposed, the right lobe inverted and the capsule (exaggerated) put on the stretch. The vessels are shown between the posterior surface of the gland and the capsule. Note that no inferior thyroid trunk appears, only branches of the inferior thyroid vessels being seen. Superior vessels of the left lobe are shown tied, the lobe mobilized and clamped. Isthmus obscured by inverted right lobe.

above the point intended as the upper limit of the incision for one often finds it necessary to extend the limbs upward in cases with highly located upper poles.

Starting now from one end of the proposed incision, injections of the solution are made along the incision at right angles to the skin, the needle being inserted to a depth of one half to one inch according to the amount of subcutaneous fat. From fifteen to twenty minims are injected at a time at intervals of one and one half inches. This infiltrates the subcutaneous fat and platysma muscle, both of which contain a few blood vessels, the cutting of which may at times cause slight pain. When the injection is complete the appearance will be somewhat similar to Fig. 1. With a sharp knife an incision is now made corresponding to the line of injection as high as seems necessary on either side. The writer has been pleased with a hollow ground flexible bladed knife devised by him and described in SURGERY

GYNECOLOGY AND OBSTETRICS for January 1912. It is better to make the incision too high than too low, in order not to be handicapped in exposing the upper poles. This incision should extend through the skin down to subcutaneous fat but not into it. In the illustration (Fig. 2) the incision is shown only at one point.

In the middle of the U shaped cut the incision is now deepened with scissors through subcutaneous fat and platysma muscle so that the blunt pointed scissors may be inserted beneath the muscles by separating the points of the scissors as shown in Fig. 2. The platysma is loosened from its attachment to the underlying structures sternohyoid, sternothyroid and sternomastoid. When these structures have been freed for a short distance by separating the points of the scissors, the platysma and fat are cut with the scissors through the line of the skin incision. More of the muscle is then freed and cut, until the underlying platysma and sub-

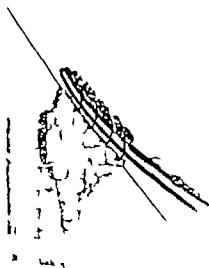


Fig. 3. The incision is made through the platysma muscle and the thyroid gland is exposed.

cutaneous fat beneath the skin incision have been cut on both sides. The advantage of this method over that of carrying the cut through skin fat and platysma with a knife throughout the whole incision is that the large veins such as the anterior jugular running longitudinally on the neck are not cut across and troublesome hemorrhage produced. These veins which in many cases there are several of the size of a lead pencil and larger are firmly fixed to the sternohyoid, sternothyroid and omohyoid muscles. Their attachment to the overlying platysma is but a loose one and permit of very easy separation as described above. By this method the incision is completed and carried down to the layer of muscles covering the gland with a bleeding except from these ten small vessels which are encountered in the skin and subcutaneous fat.

A double hook is placed in the center of the incision and the flap which has been marked out by the incision is now turned up a sharp knife being used for the dissection and care being taken to avoid as much as possible the large vein plexus of above which are adherent to the underlying muscles. No injection of novocaine is necessary to carry out this step as the injection of the ascending limbs of the U-shaped incision has so blocked the area that the dissection is painless.

With the flap turned up and held by an assistant infiltrations are now made as shown in Fig. 3 along the anterior border of the sternomastoid on each side and longitudinally in the

middle line where the sternohyoids of either side meet. No further injection of novocaine will be necessary except for the purpose of inserting a drain through a stab incision later. The sternomastoids are now freed from the sternohyoids, sternohyoids and omohyoids where they are adherent at their anterior edge and an incision is made in the middle line through the line of infiltration down to the surface of the thyroid gland. The fingers are then swept over the anterior surface of the gland beneath the muscles to free any delicate adhesions between the gland and the muscles. Clamps are placed across the sternohyoid and sternothyroid and these muscles are cut across and turned up. The operation may then proceed by whatever method of partial thyroidectomy one may favor.

The technique described and employed by the writer has been as follows. The superior thyroid artery and vein are first ligated between ligatures or clamps. The permit of mobilization of at least the upper half of the gland and in most cases of the entire portion from out its capsule on the posterior surface. One may then continue the dissection around the inferior pole with the capsule well demonstrated in the region where it is important to remain inside that structure. The capsule is cut from the outer edge of the gland where it is placed on it and it is put up the stretch so that it is always demonstrable. Double hooks are now locked on the external border of the gland and the gland may then be turned bottom side up by dragging the whole gland by its outer border toward the median line. In the illustration (Fig. 4) its upper pole is unligated so as to have the relation of the gland to the vessel of the upper pole and to the vessel of the lower. The superior vessel of the left side has been illustrated as ligated and cut having that pole mobilized. The countertract on brought it out by pulling the gland to the side and the capsule to the other put the branches of the superior thyroid artery and vein in the stretch so that they can be clamped close to the posterior surface of the gland well within the capsule and away from the region of the recurrent laryngeal nerve. As each set of vessel is mobilized and at the gland may be carried farther toward the opposite side until its junction is completely dissected from the trachea. When this is completed a clamp is applied to the isthmus at its junction with the left lobe and the right lobe and isthmus are cut away. The thyroid is then in the jaws of the clamp is then seen over and over with plain or sized cutgut the clamp removed and any additional sutures

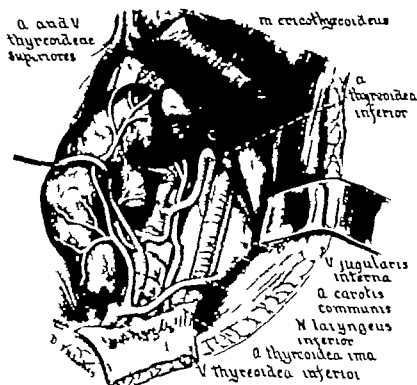


FIG. 6. Anatomical dissection of posterior surface of thyroid showing its relation to nerve, artery, and vein. Note that inferior thyroid artery enters gland at the side and from above rather than at the bottom from below. Note that inferior thyroid artery. Note that gland when in its bed rests on recurrent laryngeal nerve.

necessary to control oozing are inserted. A small sponge is now laid in the cavity from which the right lobe has been peeled and no attempt made to ligate the vessels already clamped on that side until the remaining portion of the operation on the left lobe has been completed. The left superior thyroid artery and vein are now ligated. On the right the capsule again demonstrated the upper portion of the gland mobilized and a clamp applied as shown in Fig. 4. The point on the gland at which the clamp is placed is to be determined by the amount of thyroid tissue to be left behind. In some cases it will be necessary to apply more than one clamp to completely grasp the whole of a thick gland. The upper portion of the gland is cut away and the clamps moved over and over with cautery at the isthmus (Fig. 5). All vessels are now ligated, clamps removed and any further oozing controlled by ligature or suture. If the field be completely dry and the capsule of sufficient thickness its outer border may be sutured to the bumps of the thyroid so that the dead spaces made by the removal of the gland are obliterated. If not a drain is inserted through a stab wound below the line of incision. The

neck muscles are then sutured the skin and platysma restored and a dressing applied. No further injection of novocaine is necessary in suturing muscles or skin.

In order to demonstrate the anatomy of the posterior surface of the thyroid gland the writer had made the drawing Fig. 6 which is a reproduction of an anatomical dissection made under the writer's direction in the anatomical laboratory of Tufts College Medical School. In this illustration the posterior capsule has been removed to show the course of the inferior thyroid artery and the relation of the recurrent laryngeal nerve to that structure, the trachea and the posterior surface of the gland. From this illustration one may see how well the upper portion of the gland may be mobilized after ligation of the superior thyroid artery and vein. By comparing this dissection with Fig. 4 one may see also how traction outward on the capsule tend always to keep the recurrent laryngeal nerve from being pulled from its bed beside the trachea and how inversion of the gland by traction inward allows the vessels to be clamped on the stretch close to the gland and well away from the region of the nerve.

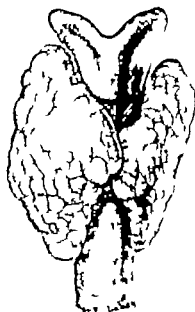


Fig. 7 Diagrammatic illustration of dissection of thyroid gland—portion remaining after operation

Attention is called to the thyroid ima artery appearing in this dissection and its relation to the gland. It occurs in about 10 per cent of cases.

Figure 7 illustrates the amount of thyroid tissue removed and its relation to the entire gland—the amount removed being readily increased or decreased by raising or lowering the dotted line indicating the point at which the clamps are applied to the left lobe.

The advantages of this method of operating are that the operation is completed with as little dragging as possible and that it leaves behind the inferior pole on one side. The writer believes that it is easier and safer to leave behind a portion of the inferior rather than the superior pole for the following reasons: first, since the superior pole peels out of its bed so easily, one is safer in that region of wiping off and leaving behind the parathyroid. This is not true of the inferior pole, which is adherent and where the vessels are multiple and clamped as branches rather than as a trunk. Second, there is less danger to the recurrent laryngeal nerve when the inferior pole does not have to be mobilized. Third, it is easier since fewer vessels have to be clamped and tied and less bleeding is encountered.

The writer has records of fifty-seven consecutive thyroid operations in which he has applied

this method of anesthesia. In four the anesthesia was a complete failure in that ether had to be given for the whole operation or should have been given on account of the suffering. Two of these cases received a solution rather than the tablet of scopolamine that were used exclusively before these two cases and have been since that is two of the complete failures received a different kind of scopolamine than any of the others in this series. It is said that scopolamine deteriorates in solution. This does not the writer believes alter the fact that they were failures particularly as the two other cases were just as complete failures although they had received the kind of scopolamine used in all but the two above noted cases.

Three cases were unsatisfactory in that the patients were awake and complaining considerably throughout the operation.

Two cases received a little gas. One was given just enough to put her under while a cyst was dissected out of the right lobe, a procedure requiring not more than ten seconds. Another acutely toxic case was given not more than a few bagfuls while the right lobe was being dragged up. In both of these cases the operation was completed painlessly with no further gas as soon as the dragging and prying was over. One case received a few whiffs of ether while an intrathoracic adenoma was being extirpated with great difficulty from the chest cavity. These three cases the writer believes should be considered failures only to a small degree since by far the greater part of the operation was completed under the influence of the anesthesia as administered by the method herein described.

In the remaining cases response to the scopolamine and morphia varied considerably. Many cases came to the operating room snoring and continued to snore throughout the operation. Some because of their apprehension were vainly endeavoring to remain awake until the operation started but went to sleep and snored as soon as they realized that they were not to be hurt. A few remained half awake but uncomplaining throughout the whole operation. A majority awoke in bed not realizing that the operation had been done and having no recollection of it. In the cases requiring ether relaxation occurred with a much smaller amount of ether than is ordinarily required and in a very short time.

There were no cases of excitation. The writer wishes to state in this regard that he believes that many patients under the influence of scopolamine and morphia are very easily antag-

onized by commands and harsh remarks just as are certain individuals while under the influence of alcohol. One of the essential factors therefore in this method is that no remarks whatever shall be addressed to the patient. Attempts to reassure her will only serve to awaken her stir up her apprehension and result often in a failure of the method. If the patient is awakened by strong traction on the gland by an instrument dropping on her or by an assistant leaning on her the operation should be stopped and perfect quietness maintained. The patient will again sink into a snoring sleep when the operation may be continued. The writer has repeatedly seen this happen. In the last case cited above in which a few whiffs of ether had to be administered he feels that had the patient not been roughly ordered by one of the nurses to put her head down her resentment thus being aroused she might have again returned to the snoring state in which she had been until too vigorous prying with the fingers in the chest awakened her and that the operation might have been completed without the general anæsthetic. This patient had no recollection of the operation.

In discussing the merits of this procedure—local anæsthesia, scopolamine and morphin—it is the writer's aim to present as prominently what he considers its drawbacks as he does its advantages for he realizes that an individual is prone to become enthusiastic concerning the value of any method that has received so much of his attention as to become almost a hobby.

To the mind of the writer there are certain unavoidable drawbacks to the method which will prevent its application in all cases.

#### DISADVANTAGES

1. Scopolamine and morphin do not act similarly upon all individuals failing at times to produce a sufficient depth of sleep to make local anæsthesia desirable. It is his feeling that this failure is in part due to the temperament of the patient and with that a lack of susceptibility to the drug. It is advisable to use the same kind of scopolamine always and in tablet form.

Some surgeons are not themselves of the temperament which permits them to complete such an operation with the deliberateness and gentleness necessary to its success. The writer personally feels that his own temperament is at times somewhat lacking in this respect and so makes this statement without bias.

More time is required for the operation under this form of anæsthesia than the

4. Operating room conditions are not always favorable in a large hospital.

5. A higher degree of technical skill is required to perform the operation with local anæsthesia than with general anæsthesia.

6. Objection may be raised by some to the use of scopolamine itself. Since the writer has had no cases where any untoward symptoms either of depression or excitation have occurred and since he always administers these drugs in fractional doses he does not see any objection to their use.

#### ADVANTAGES

1. It is safer not only in the cases in which it is a complete success but even in the cases that are such complete failures as to require ether. There have been no deaths in this series of cases. While it is possible that such a record may be the result of good fortune the writer is constantly impressed with the fact that the recovery seems to him very much less stormy than in the cases done by him with ether. General statements should bear little weight in such questions as this but it must be remembered that one's decision as to whether a given case will stand partial thyroidectomy or not must rest largely upon his general impression of the case. There were several cases in this series which the writer feels justified in stating he would not have been inclined to submit to partial thyroidectomy under ether.

2. It is very much easier for the patient. The writer believes this is true because of the fact that the scopolamine and the morphin remove to a large degree the excitement and psychical disturbances which are present when a toxic case enters the operating room in full possession of his or her faculties. The psychical disturbance is almost completely removed in the entirely successful cases. In the partly successful cases it is removed much more than by ether and in the non successful cases those in which ether or gas has to be given it is at least no worse for the scopolamine and morphin decidedly diminish the amount of ether or gas necessary in the case.

3. It requires of the same surgeon better technique and greater gentleness than would have to be demonstrated with the patient under ether and this becomes a further safeguard to the important structures adjacent to the thyroid gland and to the patient's general condition.

4. It permits of stopping the operation at any time and the immediate cessation of the further production of shock.

## CONCLUSIONS

The writer does not believe that the method will ever become popular in busy clinics or with infrequent operators on the thyroid gland for self evident reasons: length of time required for the operation; necessity of personal attention to cases; and increased technical difficulties. But he is inclined to believe that individual surgeons

who are interested in thyroid surgery if they will take time to become familiar with the method will obtain better results in the long run than with either nitrous oxide.

So convinced is he of its value that he would never of choice submit any greater case to an other operation without first attempting the operation according to this method.

## A NEW METHOD OF CONTINUOUS DRAINAGE FOR EMPYEMA

BERMAN B. THOMAS, M.D., N. Y. N. Y.

P. II

Vol. II

IT is a well recognized fact in the medical profession that the treatment of empyema is unsatisfactory. Everyone who has an experience with this condition will agree that present conservative methods of treatment are much behind the times as compared to medical and surgical progress along other lines. A little thought on this question reveals the fact that there are certain surgical and physical principles to be strictly observed before perfection in the treatment can be reached. The present is an era in medicine and surgery where every advance, every perfection, every detail in thoroughness are combined to improve therapeutic results. No effort therefore should be spared to better our almost lamentable results in the treatment of empyema.

The two factors which contribute most to the chronicity of empyema are (1) the disturbance of the negative pressure in the pleura (2) secondary infections. There is no doubt at all that where throughout the course of treatment of empyema it is possible to exclude these two factors the chronicity of this condition will be very much shortened. In addition it would preclude the necessity for the occasional subsequent radical operation.

In an attempt to perfect a method of continuous drainage for this condition and at the same time to exclude atmospheric pressure and secondary infections I have devised a special cannula which is practically non obstructible with which one can drain the pleura through an intercostal space into an air tight receptacle. Special provision is made for the attachment of a suction pump and a negative pressure manometer (see Fig. 1). This makes it possible to maintain an desired negative pressure in the pleural sac while draining it.

The advantages of such an apparatus are apparent and numerous. The control over the negative pressure throughout the treatment insures against primary collapse of the lung and its coincident grave dangers. It also affords a means of keeping the lung expanded automatically thus promoting early adhesion between the pleura and preventing the formation of a false pye. The non obstructible cannula which is a trocar cannula convertible into a cannula with a hiddenurette assure ample drainage and obviates rib resection or other operative procedures (Figs. 2 and 3). With this method the original dressing is the only one so that secondary infection from extraneous sources is practically impossible. The many obvious disadvantages that we are all familiar with are entirely obviated with all the pus accumulates in the receptacle (Fig. 5). The entire procedure tends to shorten the duration of the treatment and affords a method which is scientific, sanitary, pleasing and simple. The truth of the preceding statement is well illustrated by the following preliminary report of a few cases treated with this method.

Before citing the case histories I shall very briefly describe the apparatus that reference to it in the histories will be clearly understood. It consists essentially of four parts: (1) a special cannula with a suction cup to hold it to the chest wall (2) an air tight receptacle (3) a negative pressure manometer (4) a suction pump (Figs. 1, 2, 3, 4). These parts are connected by thick rubber tubing so as to make an absolutely air tight system when connected to the pleura. The special cannula is so constructed as to be used as a trocar cannula for the thoracotomy after which the cannula being left *in situ* the trocar portion can be converted into a curette.

and used to cleanse the cannula when necessary without removing it from the chest wall (Figs 2 and 3). This change from a trocar to a curette is accomplished without any leakage of air through the cannula. The cannula is held tight to the chest wall with a rubber suction cup through which it projects into the thorax sufficiently far to have the orifice of the cannula flush with the parietal pleura. This is to preclude any possibility of traumatizing the lung or visceral pleura with the rigid metal cannula. The cannula is connected by heavy rubber tubing to the receptacle in this case a glass bottle with a two hole rubber stopper. An indicator is suspended at the orifice of the inlet into the bottle and if the cannula is not obstructed it will move with every act of respiration. Should the indicator be immobile it would mean that the curette should be used and the cannula cleaned. Some more rubber tubing connects the receptacle to a negative pressure manometer and a suction pump which are both detachable (Fig 3).

Before the apparatus is applied a preliminary puncture is made to determine the thickness of the chest wall. This is done as follows. An aspirating needle with syringe attached is inserted just beneath the skin and a vacuum is produced in the syringe by withdrawing the plunger. The needle is now very slowly introduced into the thorax. When the first drop of pus appears in the syringe the point where the needle disappears into the skin is marked off. The distance from this point to the tip of the needle is equal to the thickness of the chest wall and is the length desired for the cannula to project from the proximal surface of the suction cup. Having adjusted the cannula within the suction cup the proximal surface of the latter is covered with a thin layer of vaseline. A clamp is placed on the tubing just distal to the cannula. The trocar cannula is now thrust through an intercostal space the suction cup is made to approximate the chest wall and its rim is sealed to the skin with a collodion cotton dressing. A negative pressure of 10 millimeters of mercury is established in the receptacle and tubing up to the clamp distal to the cannula. After the cannula has been securely fastened into the chest wall the clamp is released and drainage starts without any change in pressure. The subsequent treatment as long as the apparatus is on consists of attaching the manometer and suction pump every day or every other day to produce the desired negative pressure and using the curette when the cannula is obstructed.



Fig 1 Shows the complete apparatus attached to the patient with the pus draining automatically into the receptacle

CASE 1 on the service of Dr. H. M. Silver at Gouverneur Hospital. G. N. age 3. Family and past history negative. *Pneumonia*. Three weeks prior to admission to the hospital patient was taken ill with high fever, cough, and labored respirations. The condition lasted for one week when the child suddenly became very much improved. For one week after the child appeared to be quite free from all symptoms when she gradually became ill again with fever and continuous cough. Her condition became worse until her admission to the hospital.

Physical examination on admission to the hospital on February 3, 1916 showed an anemic and very poorly nourished child flushed and coughing incessantly. The physical signs of the chest were those of fluid in the right pleura, i. e. expansion was much diminished in the right side, vocal fremitus breath and voice sounds were entirely gone from the right side anteriorly and posteriorly. The heart apex was displaced to three inches from the left border of the sternum in the fifth space. An exploratory puncture was done in the eighth space in the mid-axillary line and about 10 cubic centimeters of thick creamy pus was aspirated. Smear and culture from the pus showed only pneumococcus.

X-ray on February 7 also showed a dense shadow occupying the entire right side of the thorax and the heart displaced slightly to the left (Fig 6). Temperature 102.5, respiration 30, pulse 130. On February 10 the apparatus was applied. A negative pressure of 10 millimeters of mercury was established throughout the tubing and receptacle before the drainage was permitted to start. After the cannula was securely fastened to the chest wall and the connection made, a tight clamp on the tubing distal to the cannula was released and the drainage of pus from pleura to receptacle was established and continued automatically without any change in pressure.

On February 1 the manometer was attached and the negative pressure decreased to 20 millimeters of mercury. Considerable fibropurulent discharge had accumulated in the receptacle. The indicator was moving with every respiratory motion. On February 3 the indicator was motionless. The cannula was cleansed with the curette without disturbing the dressing or the negative pressure. After which the indicator was seen to move again with every respiratory motion. The temperature was normal and condition very much improved. February 4 drainage normal. Pressure maintained at 20 millimeters of mercury. February 6 cannula obstructed, cleaned







Fig. 6 CASE 1 before the apparatus was applied



Fig. 7 CASE 1 13 days after the treatment was started

bacilli. Von Tuzquet reaction was slightly positive. Here was a child in very poor physical condition who had she been compelled to combat in addition to a severe wandering pneumonia the respiratory embarrassment and toxemia of secondary infection which usually follow other methods of treatment of such a condition would if I may venture my opinion undoubtedly have succumbed to her ailments.

In this case the apparatus had been applied for 13 days. Drainage ceased entirely in 16 days. The first dressing was the only one as long as the apparatus was applied and there were but three dressings subsequently. One liter and a half of fibropurulent discharge accumulated in the receptacle.

CASE 2 on the service of Dr. John F. Erdmann at Gouverneur Hospital. A 25-year-old male. Family and previous history normal. Always enjoyed good health. General history denied. On February 18 the patient was admitted to the hospital suffering from a penetrating stab wound of the right chest. Interstitial emphysema was present. The wound was treated two inches to the inner side of the lower angle of the right scapula and was three-fourth of an inch in length. The wound was thoroughly disinfected but not probed. On the chest strapped. Seven days later the patient was discharged from the hospital.

apparently cured. Four days later the patient was readmitted to the hospital with high fever, decided dyspnea, and complaining of very severe pain in the right chest.

Physical examination on admission March 1 showed a young man well nourished perspiring freely in a high fever and very short of breath. Further examination negative except for the chest. The heart apex was pushed over to the left four and one-half inches from the sternum. The entire right side of the chest front and back was flat on percussion and breath and voice sound were entirely absent. Respiratory motion was entirely abolished on the right side. Temperature 103, respiration 38, pulse 120.

X-ray of the thorax on the next day showed the entire right side of the chest to be occupied by a dense shadow and the heart shadow to be displaced to the left (Fig. 8). An exploratory puncture produced 10 cubic centimeters moderately thick pus which showed short chain streptococci in pure culture.

The apparatus was applied and a negative pressure of 40 millimeters was produced throughout the entire apparatus before drainage was permitted to start. The canula was obstructed on the third day and was disinfected with the curette without disturbing the dressing or the negative pressure. The pressure was decreased to 30 millimeters the next day.

X-ray on the fifth day showed complete obliteration of the pleural sac (Fig. 9). The right lung was completely expanded with the heart restored to its normal position.

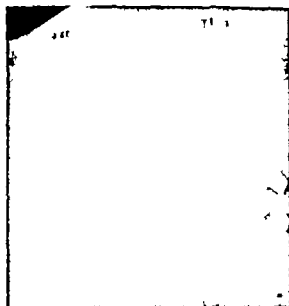
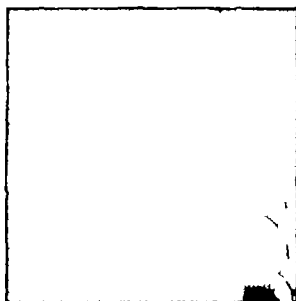




Fig. 10 Case 3 before the apparatus was applied



Fig. 11 Case 3 on the fourth day of treatment

ity infections are all contributory factors to the high mortality of this condition in the weakly constituted little ones. It is most probable that with the numerous advantages it presents this method will lower the high mortality very considerably. This method should also find a special field of usefulness in the treatment of hydrothoraces. Here the displacement of heart and mediastinum make the treatment exceedingly dangerous at times because of the change of intrapleural pressure coincident with the procedure. With this method the closest to the normal physiological condition can be preserved while the fluid is permitted to drain automatically from the pleural sac.

Your attention is called to the accompanying roentgenographs which demonstrate conclusively the efficiency of this method. Figure 6 represents the empyema present in Case 1 before the apparatus was applied. Figure 7 shows the same patient 13 days later with the intrathoracic condition restored almost to normal. Figure 8 shows Case 2 before the treatment was instituted and Figure 9 shows the same patient 5 days later with the pulmonary condition restored to

normal. Figure 10 shows Case 3 before the apparatus was attached and Figure 11 shows the same patient 4 days later with the condition almost cleared up. (The light shadow in the lower and outer angle of the left pleural sac is thrown by the rubber suction cup and not by anything in the pleural sac.)

I fully believe that with an early diagnosis of empyema and the immediate institution of a method of treatment which presents the advantages enumerated previously we have an absolute prophylactic to the pathological condition which we all dread, i.e. an extensive fibrinous exudate, a contracted lung and a big dead space secreting endless pus. Quick diagnosis and treatment of the condition should preclude the necessity for extensive rib resection operations, lung decortication and other operative procedures.

Opportunity is here taken to extend my sincerest thanks and appreciation to Drs. John F. Erdmann and H. M. Silver for their very helpful encouragement and for the courtesy of allowing me to treat with this new method these cases on their services.



with a fan (2) is connected to the lowest tube, so that the oil can be pumped steadily through the tube into the hollow applicator (5) and back to the heating plant. As the oil (or water if the operator does not wish to go above 212°) goes back to the heating plant it runs over a thermometer (4)

enclosed in a glass tube which enables the operator to see at all times the exact heat that is being applied. A thermostat is made with the heating plant which enables it to hold its heat at any given temperature which is governed by a screw in the side (6)

## NEW METHOD OF APPLYING AUTOGENOUS INTRAMEDULLARY BONE-TRANSPLANTS AND OF MAKING AUTOGENOUS BONE-SCREWS

By EMIL J. HOGLUND, M.D., CHICAGO

Assistant Orthopedic Surgeon, Rush Medical College

IN the remarkable development of bone surgery during the past few years the most conspicuous feature is that the use of foreign material such as steel plates, wires, nails, screws, bands, etc., has been practically abandoned. Wherever possible every surgeon of experience now prefers to use autogenous or autoplasmic methods, and this field is being rapidly developed. Intramedullary transplants, inlays, bone pegs, and bone screws have a wide range of usefulness, and will be universally employed as soon as the profession has mastered the technique.

The author's electric motor saw outfit, including the rotary chain saw and automatic trephine, as presented to the profession May 7, 1913, has proved extremely useful and has attained great popularity. A new device has recently been added to facilitate the cutting of the bone in deep wounds, especially in operations upon the femur. In work of this kind the ordinary motor saw cannot be conveniently used, since the blade is placed at right angles to the long axis of the

handle, and it is necessary either to use very long incisions or to sacrifice speed and accuracy. The author now presents a twin saw attachment (see Fig. 1) of small size but high efficiency, projecting directly forward from the end of the handle, which can be used with ease at great depth.

### NEW OPERATION FOR FRACTURE OF LONG BONES OCCURRING ESPECIALLY NEAR THE JOINTS

The author has also devised a new operation for fractures of the long bones by which an efficient and powerful intramedullary splint can be made from the fractured bone itself and placed in position with the greatest ease and rapidity. Using for example a transverse fracture at any

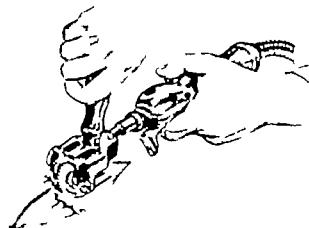


Fig. 1. Twin saw attached to the instrument running parallel to the handle.

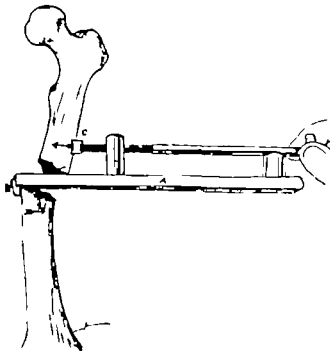


Fig. 2. Showing bar for mechanical traction, and with removable screw attachment for setting the bone fragment in place.

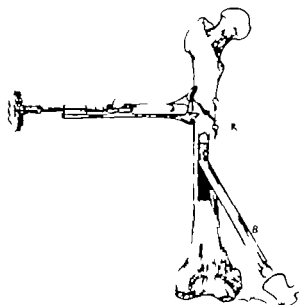


Fig. 3. Improved method of inserting the bone graft into the medullary canal of the femur. The graft is inserted into the canal of the femur.

part of the femur still and ununited the procedure is as follows:

The fractured ends are exposed, cleaned and freshened. The sclerosed bone plugs are removed from the ends of the medullary canal in each fragment by a round burr or curette.

By manipulation (preferably mechanical traction) the overriding is corrected and the ends are brought together by a clamp of the Schroeder type or by the author's sample bar with screw attachment (as shown in Fig. 2) or by various other means. The ends are held in proper alignment by the clamp described above or by my own improved four pronged wire Loman clamp shown in Fig. 3.

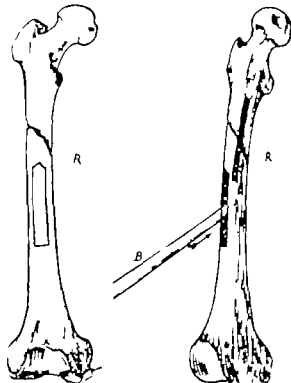


Fig. 4. The left picture shows the bone ring holding the graft in place. The right picture shows the bone graft inserted into the medullary canal of the femur.

A bone splint of a width corresponding to the diameter of the medullary canal is now cut by the twin saw for example from the shaft of the femur. The size of the canal should always be carefully noted before the bone fragments are placed end to end.

The original feature of this operation is the method of cutting the graft at a distance of about

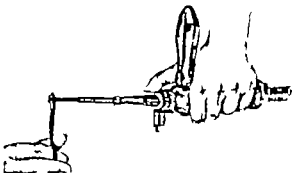


Fig. 6. Cutting the bone graft from the bone stock.

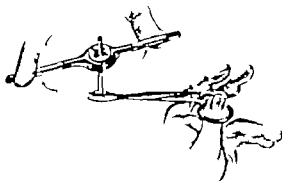


Fig. 7. Cutting the bone graft from the bone stock.

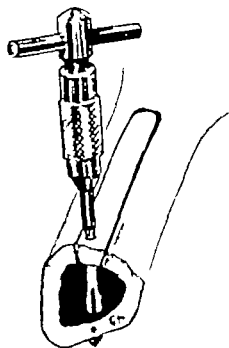


Fig. 8. Threading the holes through the inlay and opposite compact bone for the bone screw.

one inch from the fracture so as to leave a *complete ring of bone* (see Fig. 4, R) at the fracture end thus contributing enormously to the strength of the union. The graft is of course, cut from whichever fragment is the longer or the more easily denuded of soft tissue. In the adult femur the graft will be about a half inch wide and three inches long depending upon the angulation of the fracture. The cutting is readily done with the twin saw, the blades being sunk at once to the full depth at the start then being pushed along as far as needed. The ends of the graft must now be cut across and this can be done with a thin and very sharp chisel preferably Murphy or much better by the author's small thin circular saw which can rapidly be attached in place of the twin saw. A V shaped cut should be made at the end nearest the fracture and at the farther end a direct cross cut. This leaves one end of the graft pointed (see Fig. 4).

The splint is now dislodged with the chisel (but not removed) and pressed down in the medullary canal with the pointed end toward the fracture. With a blunt tool or the special instrument shown in Fig. 3, B the splint is now driven into the canal across the line of fracture so that half of the splint will be in each fragment (Fig. 5). It will be securely held against any



Fig. 9 (left). Case 1. Fractured tibia and fibula before operation.

Fig. 10. Case 1. One month after.

kind of lateral displacement by the intact ring of bone in the fragment from which the splint was removed.

This method is offered as being the easiest and fastest method yet devised with the least handling of the bone at the operation for applying an intramedullary autogenous bone splint. It is much stronger than a bone inlay although many operators may still prefer the inlay method for which the author's twin saw is equally well adapted. Here it has an ingenious adjustment of the saw blades by which after the recipient groove has been cut the blades can be separated just far enough in cutting the graft to make an absolutely exact fit. If this is not done the graft will be too narrow by the thickness of the saw blades. This adjustment is controlled by a set screw fitting into drill marks on the shaft at the proper distance one of the saws sliding along the shaft.

#### AUTOGENOUS BONE SCREWS

For holding inlays for spiral fractures for ununited fractures of the neck of the femur and for fractures of the olecranon patella the condyles of the humerus and femur as well as of the malleoli the author uses autogenous bone screws which are made from strips of bone by





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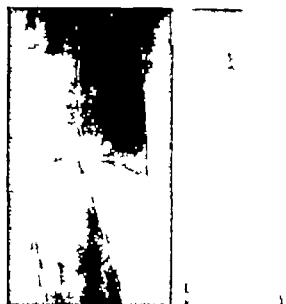


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pressing them through the dowel cutter as shown in Figure 6. Two sizes of cutters are furnished. A thread is then cut upon the dowel by means of the screw plate (Figure 7) and the recipient bone is drilled and threaded by the appropriate drill and tap (Figure 8). The advantages of the screw as compared with the peg are that the screw is certain to hold even if it be loose and that it will hold fragments together against a lateral strain as well as against longitudinal strain while on the other hand sometimes the drill will make the hole too large if not properly ground that is if one of the cutting edges on the drill is a little longer than the other thus making the bone peg fit loosely.

It must always be remembered that the bone transplants and screws are not very strong and that the limbs must be handled with the greatest care while the plaster of Paris cast or other immobilization apparatus is being applied. Good assistants are necessary and a traction appliance or fracture table similar to those designed by Hawley, Fehob, and others is of the greatest value.

I wish to report briefly the history of the first three cases.

Case 1. Patient M. C. male age 35. Ill no Central Railroad employee. Inevitably involved in important case of osteomyelitis. On May 10, 1906, while working at plant in bridge the hammer fell and hit rail which in turn hit his leg, causing compound fracture of the lower third of left tibia and fibula. A large bone fragment. Some infection on set, but after treatment it was found that if ever healed it was ununited (see Fig. 9). Operated on by above method at Ill.

Case 2. Central Illinois Railway Co. No infection. The roentgenogram (Fig. 10) shows a good position and perfect results.

## END TO END ANASTOMOSIS OF THE COLON

BY P. LOCKHART-MUMMERY, F.R.C.S. LONDON, ENGLAND

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 Bowel City of London and Fulham Midway Hospital, Hammersmith, London, W.6.

SOME sixteen years ago the popular method of joining different portions of the intestine in forming an anastomosis after resection was by means of some form of apparatus aided by stitching. Murphy's button, Senn's plates, Allingham's bobbin, Mayo Robson's bobbin and Laplace's forceps all had their advocates, and any surgical textbook of that time contains numerous illustrations and descriptions of the method of using these appliances. Of these probably the most popular was Murphy's button, which held the field for some time owing to the ease with which it could be used. But the not infrequent fatalities which attended its use, the fact that the button was not always passed but had to be removed by operation, and the trouble from stricture due to the small size of the stomach have led to its disuse. With increased experience and improved technique surgeons soon found that plain stitching gave much better results both in time and safety, and at the present day no good surgeon would think of using any of these appliances when doing an anastomosis either of the large or small bowel.

When stitching first took the place of these mechanical appliances for joining the bowel, lateral anastomosis was used in preference to end to end anastomosis. At the present day lateral anastomosis is used only for the large bowel, while end to end anastomosis is always employed for the small bowel. I propose to consider the reasons for this and to suggest that lateral anastomosis should be entirely discarded.

That there are still a considerable number of well known surgeons who use lateral anastomosis when uniting the colon is clear from recent writings. In Sir Berkeley Moynihan's recent book on *Abdominal Operations* lateral anastomosis is given as the method of choice when dealing with the colon, although no good reasons are given for this preference. In the last edition of Cheyne and Burghard's *System of Operative Surgery* in the description of anastomosis of the colon we find the following: "Axial union, although it has often been performed, is not to be recommended. Lateral anastomosis is the preferable method." In the sixth edition of Jacobson's *Operative Surgery* axial union is advised, but the general opinion seems to be

very much in favor of side to side union as evidenced by recorded cases.

A natural query is: What are the reasons which have led surgeons to adhere to lateral anastomosis of the colon after it has been entirely discarded for the small bowel? The obvious disadvantages of lateral anastomosis are: (1) It requires a much greater length of bowel for this purpose, and consequently either more extensive freeing of the colon or less extensive removal of the diseased portion as compared with axial union. This is a particularly serious disadvantage when dealing with the colon as the amount of bowel is always strictly limited. (2) The operation takes longer to perform as in addition to the actual anastomosis the ends of bowel have to be sealed off. (3) The subsequent anatomical condition is not a normal one, and the blind end of the proximal portion of the bowel sometimes gives trouble from dilatation and pocketing beyond the stoma; in some cases this has even led to ulceration and abscess.

The reason that axial anastomosis of the colon has not been popular is that it was found that the mortality from this operation upon the large gut was high. Whereas axial anastomosis in the small intestine was a very successful operation with a low mortality, it was found that axial anastomosis in the large intestine frequently failed, being followed either by fatal peritonitis or by the development of a fecal fistula. It was supposed that the lack of success in anastomosis of the colon was due to the more solid nature of the contents as compared with those of the small gut, rendering the line of suture more likely to give way. It was however found that the lateral anastomosis was not attended by the same proportion of failures as axial union, and therefore this method has become more popular. The real reason however why axial union of the large intestine so frequently failed has nothing to do with the nature of the contents of the colon, but is entirely due to the blood supply of its walls. The arteries supplying the colon pass round the bowel in a circular direction from the mesenteric border and are parallel to each other. There is very little anastomosis between the different vessels in the walls of the colon, although there is a

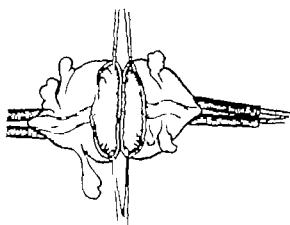


Fig. 1. The mesentery of the small intestine is divided by the forceps or tract on the bowel half way between the mesentery and the free border.

free in the abdominal cavity of the mesentery. It is, however, therefore, that in performing a resection the vessels must be transected and sutured. After this is done there will be no risk of the stitches joining the edges of the intestine. The intestine contracts and the vessels are damaged, the blood supply of the bowel edges is cut off, and the mesentery is cut. A little later, when leakage occurs after suture of the colon, it will be found that the leakage is not opposite the mesentery. The leakage is on the opposite side of the bowel where the two halves are joined together and not to inadequate or faulty suturing. In performing lateral anastomosis, the range of damaging the blood supply to the bowel edges as the arteries themselves are not caught up in a suture. All that is necessary, however, to secure a good result is to cut at an angle of 45 degrees from the mesentery outward that is to say that a larger amount of bowel is removed than free than with the other side. In this way a good blood supply is insured to the whole of the sutured edge while it has the additional advantage of making the diameter of the lumen of the bowel rather larger than normal at the point of union. Such compensation for any narrowing due to turning in of the edges. If this method of joining the colon usually is adopted leakage from the formation of a fecal fistula is no more likely to occur than with lateral anastomosis or anastomosis of the small intestine. I have used this method for years and have had very few cases in which a perfect result was not obtained.

The operation is performed as follows. The portion of colon which it is desired to resect

drawn out of the wound and the wound itself is then roughly packed off with large swabs. The loop itself is then pushed through a small hole cut in the wall which is placed over the whole of the loop. The mesentery is first divided and any vessels secured. A large swab is then placed beneath the bowel through the gap in the mesentery. In this way the wound and the abdominal cavity are completely shut off from the area of operation. Clamps are then applied well at each side of the area which it is proposed to resect, the clamps being applied in the longitudinal axis of the bowel so that the mesentery is cut through. The vessel is then cut through at an angle of 45 degrees to its transverse diameter. The two ends of the intestine are then brought together with a sufficient wedge of mesentery is removed (see Fig. 1). If the clamps are controlling blood supply in the mesentery they should now be released to make sure that there is a good blood supply to the edge of the bowel at the mesenteric attachment as if care is not taken this may be damaged in tying off the blood vessels in the mesentery. When it has been ascertained that the blood supply is entirely satisfactory the two ends of bowel are brought into contact and caught together by two pairs of tied forceps or if it is preferred by traction sutures. If there is a tendency for the mucous membrane to prolapse beyond the muscular and elastic coats it may be trimmed off with a pair of scissors so that the three coats remain as much as possible at the same level. This makes the suturing very much easier and prevents mucous membrane from projecting between the stitches. The forceps or traction sutures should be applied at the sides of the bowel half

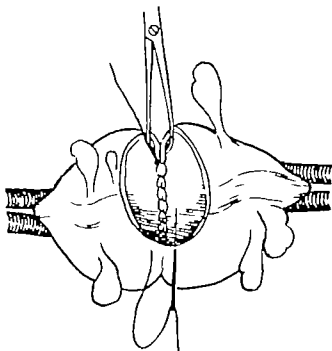


Fig. 3 When the suture reaches the opposite side of the bowel the toothed forceps are removed and the stitch is continued around until it reaches the point where it started. It is then tied off great care being taken to keep all knots on the inner surface of the bowel.

way between the mesenteric attachment and the free border (Fig. 2). A stitch of fine catgut with a short straight needle is now started from one pair of the toothed forceps and carried across to the other so as to sew the two mesenteric portions of the bowel together. This stitch should take up all the coats but should keep close to the edge so as not to endanger the blood supply. When it reaches the opposite side of the bowel the toothed forceps are removed and the stitch is continued right round until it reaches the point where it started, where it is tied off great care being taken to keep all knots on the inner surface of the bowel (Fig. 3). The clamps are now released so as to make sure that there is no bleeding. Should there be any additional sutures must be inserted to control it. A fine thread peritoneal suture is now put in starting from the mesenteric attachment on one side and picking up the peritoneum one sixteenth of an inch outside the first line of suture on each side. This is continued round (Fig. 4) until it meets the mesentery on the opposite side of the bowel where it is continued down the mesentery itself so as to close the gap. This completes the suture, and after the bowel has been swabbed over the clamps and all the towels and wabs are removed and the gut is returned to the abdomen the abdomen then being closed in layer without drainage.

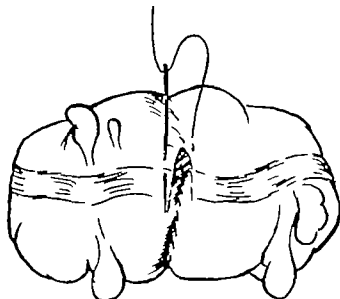


Fig. 4 Showing the continuation of the fine thread peritoneal suture until it meets the mesentery on the opposite side of the bowel where it is continued down the mesentery itself so as to close the gap.

That the suturing done by this method is very effective is proved by the following case.

Mrs. E. aged 40 was sent to me for symptoms pointing to growth in the sigmoid flexure. With the sigmoidoscope the growth could be seen and I operated for its removal. At the operation a small growth was found in the middle of the sigmoid flexure which was causing a considerable degree of obstruction so much so that at the operation the bowel above the growth was dilated and obviously much loaded with feces. For certain reasons which appeared to be important it was decided to perform resection straight away although a preliminary colotomy appeared indicated. A resection was done in the manner described above and on releasing the upper clamp a wave of material could be seen to pass down and considerably distend the line of union. No trace of leakage occurred however the abdomen was closed without drainage and the patient's bowels acted freely within an hour of the operation. Union occurred by first intention and the patient was up as soon as the wound healed.

I have now performed a considerable number of resections of the sigmoid by this method and have found it to give results which are just as satisfactory as end to end union of the small intestine or lateral anastomosis of the large. I have not had a single fatal result from anastomosis of the large bowel by this method and only two cases in which there was failure of primary union and in neither of these did a fecal fistula develop. The operation can be very quickly performed and the method of stitching the mesenteric side of the bowel is much easier than the more usual method of starting the stitch at the mesenteric attachment particularly where there is a considerable amount of fat in the bowel wall and mesentery.

*After treatment.* The bowels should be moved

on the second day by a small gruel enema assisted if necessary by a hypodermic injection of pituitary extract and after that the bowels are kept moving easily by some mild aperient. This is much better than leaving the bowels for some time which often results in the formation of scybala and in the accumulation of blood and discharge in the neighborhood of the anastomosis. The patient is given an ordinary light diet

consisting of chicken fish milk puddings bread and butter eggs etc but milk and slops should be forbidden as they tend to cause flatulence. The patient is of course not allowed to eat a large amount for the first few days but only enough to satisfy hunger. Liquid petroleum by the mouth in half ounce doses three times a day is very useful in preventing the formation of scybala.

## CORRESPONDENCE

### CHICAGO GYNECOLOGICAL SOCIETY

The Editor of the Chicago Gynecological Society will be interested to know that the \$5000.00 fund presented to the Society by the Chicago Gynecological Society for the purchase of a building for the purpose of conducting its business has been received.

The paper on the subject of the Chicago Gynecological Society in an open meeting will be published in the next issue of the Chicago Gynecological Society.

but it has not yet been received elsewhere and has not yet become the property of the Society. Any one who desires to read a paper in this connection should address the undersigned.

W. S. HENRY, Secretary

104 S. Michigan Avenue Chicago

# TRANSACTIONS OF SOCIETIES

## CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD NOVEMBER 3 1916 WITH THE PRESIDENT DR WILLIAM M HARSHA  
IN THE CHAIR

### CONGENITAL DEFORMITY OF THE FOREARM AND HAND

DR SYLVAN KUNZ The case I wish to present is that of a little girl who was born with a hand minus the thumb and a very rudimentary radius. The scar that you find is the result of an operation performed when she was seven months of age. What was done I do not know. The X ray shows that some of the metacarpal bones are lacking and the upper end of the radius while present is thinner and not near the normal size.

DR KELLOGG SPEED Are there any other bones in the body affected?

DR KUNZ None and the family history is negative on the father's side the mother's side and the grandparents side.

DR C G BUFORD This case offers an unusual opportunity. The congenital absence of about the lower half of the radius provides no resistance to the muscles and tendons on that side and therefore the hand swings well to the radial side. Without doubt the deformity thus induced may be most markedly if not completely corrected. The soft parts should be laid open and a tibial graft placed between the lower extremity of the radius and one of the larger carpal bones on the radial side and fixed there the wound closed and the entire extremity placed in a cast with the hand turned a little to the ulnar side. The tendons are more pliable in such cases than they appear to be but if they should prove too short to allow the insertion of a graft long enough to correct the deformity they may be elongated. One will be sure to get ankylosis at the wrist between the carpal bone and the graft which is of little importance now. An arthroplasty may be done later with a fair opportunity for success.

DR KELLOGG SPEED This case offers unusual opportunity for bone transplantation. The child is young and apparently in good health and a piece of bone applied to the lower end of the radius implanted in the wrist the hand held in marked ulnar flexion until the soft parts heal would probably take on some growth as it is exposed later on to functional use. The lower end of the radius should be freshened, the transplant very firmly imbedded by tunneling into the medullary cavity without the use of any foreign body and the radius

would grow and take on function proportionate to the amount of use the hand was given. The elbow joint seems to be normal. The seeming dislocation of the ulna is false. The joint there is probably perfectly normal.

DR D B PREHMASTER I do not believe that from the insertion of a transplant we can hope for very much longitudinal growth. Experimentally that has been pretty well disproved where there is an absence of epiphysis as there is in this case.

DR C G BUFORD In reference to what has been said by Dr Prehmaster about the failure of tibial grafts to grow I wish to state that about two years ago Dr F B Riley exhibited plates and photographs for me at one of our meetings. I had removed the entire tibial diaphysis from this patient and had waited a good many months for regeneration which was only partial. I finally put in a free tibial graft. It is true elongation in this case was not great. We have no means by which we can be sure that there has been any growth. We do know that the growth was so deficient that the leg bowed and to overcome this I severed the tibia corrected the position, leaving a gap which I filled with a long free tibial graft. I do not see why this cannot be done again and again as the bone grows thus preventing an undesirable deformity.

DR KELLOGG SPEED The epiphysis near the elbow begins to calcify late and if function can be started in the forearm which would call upon the bone to develop that epiphysis would take on increased growth in a general physiologic way. It would grow perhaps twice as large as it would normally under favorable conditions and being the last epiphysis to unite one might get a better looking forearm than the patient has at present.

### IMPLANTS FOR THE RADICAL CURE OF LUNG ABSCESS IN EMPHYSEMA

An abstract of Dr EMIL BECK'S paper as above follows:

Dr Beck demonstrated three cases of lung abscess from a series of seven cases which he operated upon since 1910 by a new method which he calls epidermization of lung cavities for the radical cure of lung abscess. He employs a principle which he has used in obliterating deep

seated bone cavity namely the implanting of flaps of skin into their depth. He makes a large skin flap removes a sufficient number of ribs in the area of the lung, because cavity then widens the abscess cavity and inserts the skin flap into the depth placing it in contact with the abscess.

alls without using a single suture. Quantities of gauze are then packed against the skin in order to keep the flap in contact with the abscess wall. In four days the gauze packing is removed and the skin flap is usually adherent to the abscess wall.

Should a bronchus communicate with the cavity it is cut, sometimes during the operation. Care is taken that the abscess cavity is filled with either fumes. This might cause an explosion. The ether is discontinued for five minutes and the patient given oxygen. Then he vacuum method one of the bronchial or lung is destroyed by means of the cautery.

Further epidermization of the exposed abscess surface is produced by pasting strips of plaster covering the edges of the skin flap. This procedure is very simple and produces most rapid growth of the periphery from the edges of the implanted skin gradually covering the entire surface of the granulating surface. If the abscess cavity is gradually transformed into a surface covered with skin in other words the interior of the abscess cavity transformed into body surface. After some time it remains in some cases a funnel shaped depression of the skin in others the depression has gradually become shallow and is nearly level with the body surface.

This report is not intended to demonstrate the perfect method of closing all abscess cavities in each successive case with improvement of technique has brought the author nearer the solution of this most difficult problem namely the liberation of long suppurating abscess cavities and empyema with communication of bronchial fistula.

The operation is intended only for cases which do not heal spontaneously in which the pus with paste has been tried without result. The series of seven cases reported consist of patients who have had these fistulae for as long as twenty years and in some instances the cavity extended as many as seven bronchial openings.

The author believes that the perfection of this method will eventually lead to the abolition of such mutilating operations as the Schede and Estlander or decortication of the lung.

#### DISCUSSION

Dr H. M. Richter: I would like to ask Dr Beck whether he has any ground for limiting the resection of the ribs to three or four.

I had the opportunity ten years ago before the war broke out of seeing several men abroad long

this kind of work among them. Sauerbruch has operated on two or three cases and I saw approximately forty of the patients upon whom he had operated. Sauerbruch makes it a point to remove eleven ribs. He says the removal of the first and second ribs is essential that one is not justified in leaving the first and second ribs behind. I saw Wilms remove five or six ribs and he left the first and second ribs but the general trend up to ten years ago was to remove all but the last rib which is so short and mobile that it does not prevent collapse. The operators made a long flap of soft tissues over the ribs including the entire side of the chest. They made a horseshoe shaped flap or a fishhook shaped flap. They began up high behind the inner border of the scapula extended the incision down to the eleventh or twelfth rib and then curved forward and upward turning out and

sewing eleven ribs without opening the pleura. The collapsed entire lung to collapse and the soft tissues to fill in with it without drainage. By doing such resection the operation was no more severe. I saw Sauerbruch remove eleven ribs and local anesthesia and complete the operation including the suturing of the flap in less than fifteen minutes. The patient presented no evidence of shock.

Dr L. M. Beck (closing): Answering the question of Dr Richter I will say Professor Sauerbruch employs his operation in cases of tuberculous chest with large number of ribs and allows the chest wall to fill in with sutures the skin wound. I do not cut the skin at all. I cut large sized flaps of skin and fit them into the chest cavity over the lungs. I resected ribs and allowed them to heal in thus converting the cavity in the lung (whether it be abscess cavity or an old empyema) into the outside so that I need not resect more than three or four and seldom five or six depending upon the size of the cavity. I object to resecting the entire live ribs on one side for the reason that there will be considerable deformity after the operation. He with this method there is practically no deformity. When the patient is dressed on can see any defect in his chest wall. He varies as much as possible of the posterior part of the ribs to maintain the correct position of the patient. The cut edges of the ribs will in time unite by bony union. I do not operate on the intercostal spaces. This operation I believe will in time be a substitute for the more serious operation of resection of the chest. It is such as the Estlander and Schede operations. The mortality in my series is practically nothing. I had one case out of eight having died and that one from the effects of the anesthesia.

Dr James T. Case gave a talk on "Some Functional Abnormalities in the Interpretation of Intestinal Roentgen Findings" which was accompanied by numerous lantern slides.

# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN SURGERY

Medical men are notoriously inept in many of the ordinary accomplishments of everyday life. A few clever with tongue and pen write books and book reviews. Of these few have written more interestingly than Dr Seelig whose book reviews in the past few years have illuminated the closing pages of successive numbers of this journal. It is with trepidation that we venture temporarily to fill the space he has occupied so gracefully heretofore.

MEDICAL Chicago had an articulate voice which will ring in the ears of the present generation for years to come. The last numbers of the *Clinics* of John B. Murphy serve only to emphasize how broad was the scope of his work and how fruitful his researches in every branch of surgery. In the mind of the layman the name of Dr. Murphy stood for many things some very real some rather fanciful. To the older generation of medical men he was a pioneer, a skillful technician and a brilliant workman. By the younger generation he will be remembered as the great teacher. To them appendicitis meant little more than typhoid fever or smallpox. They had not lived through the stirring days of its parturition and childhood but received that heritage full grown. So with gastrointestinal surgery, with bone and joint surgery and plastic operations that were marvels of ingenuity. They were all accepted as a matter of course with little appreciation of their technical difficulty and of the years of experiment and slow development that had gone before. But they could appreciate that dynamic personality and that fearsome voice reentering in their ears. What's the matter with him? and bidding them to listen to the story and learn. No man who has ever been called into the pit at Mercy Hospital can read a volume of *Murphy's Clinics* without visualizing the clinic of his student days and hearing again that high pitched voice speak the words on the written page. One of his students tells how in the summer following his graduation far away from medical help on the shore of Lake Superior when confronted in the middle of the night with a case of acute abdominal pain he boiled his hypodermic syringe and how that oft repeated warning "Never give the patient morphine until you have made a diagnosis" rang so incessantly in his ears that he put the syringe away and sat by the bedside until dawn and emesis brought the patient relief.

The August and October number of the *Clinics* contain reports of a larger number and greater variety of cases than earlier numbers of the *Clinics* with frequent references to similar cases reported previously. Of especial interest in the August number is a talk on ankylosis of the mandible with a resume of the differential diagnosis and technique of operation. A case of traumatic recurrent subluxation of the fourth lumbar vertebra immobilized by a bone graft after Albee's method. A talk on arthroplasty of the shoulder joint. A new series of old injuries about the elbow joint treated by arthroplasty and a talk on subperiosteal streptococcal cellulitis metastatic from the tonsils, pharynx, uterus and upper respiratory tract.

A clinic for the Baltimore and Ohio Railway Surgeons featuring the October number gives a rapid resume of a series of interesting bone and joint cases. In this talk Murphy emphasizes again the difference between the osteogenetic processes in bones immobilized by Lane plates and by bone grafts. In the former absolute immobilization may lead to non union by depriving the osteogenetic forces of the stimulation afforded by slight motion with consequent abundant callus formation. In the latter the irritation of motion causes fibrous tissue formation about the graft and occlusion of the Haversian vessels preventing bony union between the graft and the fractured fragments. He emphasizes anew the necessity of painstaking and prolonged after care to insure proper results in bone and joint surgery for example the maintenance of double abduction and extension in fractures of the neck of the femur for at least sixteen weeks. The absolute immobilization of the spine following implantation of an Albee bone graft for at least ten or twelve weeks and this followed in one case by the application of a leather jacket extending from the scapulae to the trochanters. A talk on inguinal hernia with a description of the technique of Andrews' operation and a talk on suprapubic prostatectomy according to Freyer's method are other interesting features.

To edit *Murphy's Clinics* in such a way as to systematically group his surgical teachings in one or two volumes would be an eminent service to the medical profession.

AS medical men tend to greater degrees of specialization the same trend finds expression in medical literature. Books devoted to highly specialized fields of medicine and surgery have in

THE CLINICS OF JOHN B. MURPHY. MERCY H. PITEL, CHICAGO.  
Vol. 1, and 2, August and October, 1916. Philadelphia and  
London: W. B. Saunders Company, 98.



creased rapidly in the past few years. Of such books we feel we have a right to expect a very complete and critical survey of the subject in question that we may turn to them as to a court of last resort within the realm of their jurisdiction. Dr. Elsberg's new book does not aim at so pretentious a place. He says in the preface: "The present volume is a record of personal experiences in the treatment of diseases of the spinal cord and its meninges." The attempt has been made to keep the book from extending beyond its proper limits—a consideration of the diagnosis and treatment of diseases of the spinal cord that may require surgical interference and all matter which belongs more properly to textbooks in neurology or general surgery has been given the briefest mention.

The book is well arranged. It begins with a discussion of the anatomy and physiology of the cord, the symptoms of spinal disease and methods of examination going on to the technique of lumbar puncture, laminectomy, and rhizotomy, and finally to a discussion of specific pathological conditions of the cord and its membranes. The discussion of the anatomy of the cord and its membranes is confined chiefly to facts of surgical interest. The difference in structure of the vertebral different regions, the arrangement of root bundles and direction of the nerve trunks at different levels and the relations of the dorsal ligament to the membranes and the spinal nerves and especially its peculiar conformation at the level of the first lumbar vertebra are clearly set forth. The diagram illustrating the relation of the segment of the cord to the vertebra does not quite correspond to the description in the text, particularly as to the relation of the eighth cervical segment to the cervical vertebra. A larger and more complete diagram of the cord in cross section, possibly in color, would add to this chapter.

The diagrams of different pathological conditions are a little disappointing, especially those concerning the absence of diagrams of flowing injury.

The exposure of the spinal cord by laminectomy is described at length with numerous illustrations of instruments and the different steps of the operation. In view of the fact that the technical part of the operation has been so well illustrated, it might not have been out of place to describe a table (which is incompletely shown in the illustration) with a head rest for patients in the prone position.

Following a chapter of eleven pages on diseases and abnormalities of the spinal vessels, comparatively rare conditions are seventeen pages. Recent injuries of the cord hardly a well balanced division of space. For the general surgeon injuries constitute the most common surgical cord lesions. It is to this chapter we fancy we would first turn in reading a textbook on surgical diseases of the cord. Of especial interest to him is the question as to

what cases should be operated upon. With reference to this question the author says in discussing the indications for laminectomy: "In recent fractures of the vertebrae with injury to the cord, laminectomy should be performed only when the patient's condition is sufficiently good and when the symptoms make it clear that the spinal cord has not been completely crushed at the level of injury. To operate upon a patient with a spinal fracture who has the symptoms of complete crushing of the cord (except in the region of the cauda equina) is not only useless but is sure to throw discredit upon a surgical procedure which is most valuable in the proper cases." In discussing recent injuries of the cord he says: "If the cord has been bruised it becomes swollen and bluish in color due to edema and to small intramedullary hemorrhages or to the rupture of a larger blood vessel (hematomyelia). This edema may cause all the symptoms of a complete transverse crush of the cord; it is of a very destructive nature and may unless quickly relieved result in disintegration of the cord in its transverse diameter. How then is the surgeon to distinguish between those cases in which the symptoms are due to an actual destruction of the cord and those in which there is an acute edema or a hemorrhage pressing upon the cord?" As Sharpe says:

"Interruption of conductivity of nerve fibers after fracture does not mean that those fibers are destroyed. Probably the only statement on which all surgeons could agree is Lejars' to the effect that the last word has not yet been said upon this subject. After all the realists or may be in Oppenheim's statement quoted by Dr. Elsberg in discussing the mortality of laminectomy: "The dangers (of the operation) are small when done by a surgeon with the experience of Dr. Victor Horsley."

The chapters on rhizotomy and cord tumors seem to us the most interesting and complete. The technique of rhizotomy is well described and the indications for operation clearly set forth. The symptoms of cord tumors and the differential diagnosis between intracranial, extramedullary and intramedullary tumors are especially emphasized. Specimens of tumors removed from the cord are beautifully shown in several illustrations. The accompanying microscopic sections could surely have provided of interest to all. The trissection method of removal of intramedullary tumors first described by Elsberg and Beer in 1901 is illustrated by diagrams and reports of successful cases.

The mechanical details of the book are excellent. The illustrations are numerous and excellent. The addition of more and direct references to the literature could have added to the value of the book. To the surgeon it will prove especially valuable for the careful descriptions of the surgical pathology of cord lesions, of the anatomical considerations involved and of the mechanical details essential for successful operative work.

S. L. KOCH

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXIV

MARCH 1917

NUMBER 3

## THE CARREL METHOD OF WOUND STERILIZATION

ITS USE IN MILITARY, INDUSTRIAL, AND CIVIL PRACTICE<sup>1</sup>

BY WILLIAM O'NEILL SHERMAN M.D. PITTSBURGH

**A**t the suggestion of the Rockefeller Institute and in co-operation with the United States Steel Corporation the writer representing the Corporation spent five months in England, Scotland, Belgium and France studying the various methods of wound treatment.

The treatment of infected, gun shot, shrapnel and shell wounds had not been radically altered since the discovery of antiseptics until the perfection of the Carrel-Dakin technique. The experience gained during the past fifty years from civil, military and industrial surgery has contributed very little toward the combating of wound infection. The character of the wounds together with the nature of infection and the damage to the tissues is far greater in the present war than in previous wars. The virulence of infection surpasses anything known heretofore of wound infection. The first efforts to combat suppuration at the early outbreak of the war were woefully inefficient. Malignant suppuration was very common and all efforts to suppress it were futile.

The problem which confronted Carrel and Dakin was the same that confronted Lister; the principles laid down by both are identical. The battles in Belgium and northern France are conducted on fields that have been cultivated for centuries, the soil being enriched with the fecal material of poultry, pigs,

horses, cattle and humans. The bodies and clothing of the combatants are impregnated with the mud and dust of this highly infected soil. The opportunities for bathing and the changing of clothing are most infrequent. In many cases weeks and months elapse without change. The microorganisms present in the soil find a fertile medium in the human tissues. The organisms most frequently found are the bacillus of tetanus, the gas gangrene bacillus (*bacillus aerogenes capsulatus* of Welch), the putrefactive organisms, streptococcus and the bacillus coli. It will be seen that all these bacteria are of fecal origin. The staphylococcus pyogenes aureus which is usually found in suppurations in civil practice is found only in the late stages of the wound. The lowered state of vitality and exhaustion due to loss of sleep, exposure, anxiety and nervous strain undoubtedly lower the general resisting powers. Many of the wounded lie where they fall in No man's Land from twelve to forty-eight hours before receiving attention. The shell and bullet wounds not only cause great damage to the tissue but they carry into the tract of the wound the virulent bacteria. The delay in bringing the wounded from the firing line is lamentable but unfortunately cannot be prevented. The Red Cross and Stretcher Squads if exposed are subject to fire night and day.

It was quite evident at the outbreak of

<sup>1</sup>Read at the annual meeting of the Allegheny County Medical Society, January 9, 1917 and at the Mayo Clinic, January 1, 1917.

the war that all wounds were infected with the exception of those caused by high velocity bullets. The abortion and control of infection were the problems which confronted the surgeon. Carrel and Dakin began their research work at the Beaujon Hospital Paris in Professor Tuffier's laboratory. A research laboratory was later established at Compiègne Oise in conjunction with the French Military Hospital No. 21. Carrel's work was started in December 1914 and completed in June 1915.

Since that date the present technique with certain modifications of Dakin's solution and technical improvements in the method has been in constant use. The success obtained has been most striking. Carrel and Dakin experimented with two hundred or more antiseptics before the hypochlorite solution was perfected. Dakin's solution is not a panacea or cure all while it has strong bactericidal properties and is almost an ideal antiseptic solution because it is non-toxic and nonirritating. It must be used however with discretion and judgment.

In collaboration with Dakin (1) Druifresne Dehelly and Dumas Professor Pozzi presented Carrel's first paper before the Académie de Médecine on October 15, 1915. He pointed out that all wounds of war produced by shells, torpedoes, grenades, etc. were infected and that the methods of treatment in vogue were powerless to prevent gas gangrene, septicemia, and chronic suppuration.

**Amputations.** Tuffier states that 80 per cent of the amputations are due to infection and 20 per cent to destruction of tissue. He is confident that if Carrel's method is followed almost all amputations due to infection can be prevented. If it is necessary to amputate for loss of substance a chop or guillotine aponeurotic operation is the method of choice; this to be followed by Carrel's method of wound sterilization. By this procedure a secondary closure of the flaps can be made twelve to eighteen days after amputation. There are thousands of painful stumps with osteomyelitis, spurs and sequestra in which it has been impossible to fit artificial legs. These complications are due to infection.

Where the chop amputation and Carrel

method is employed many are able to wear artificial legs four or five weeks after they have been wounded. DePage makes his own legs at LaPanne, laying great stress on the advantages of wearing artificial legs at the earliest possible moment. When necessary lateral anterior and posterior extension to the skin flaps will usually suffice to pull down the flaps to completely cover the bone.

There are many thousands of amputations which have incapacitated the patient for six to eighteen months because of infection; the vast majority of these could have been prevented.

**Deaths.** The immediate deaths are due to trauma to some vital tissue. The failure to rescue the wounded within twenty-four to thirty-six hours has caused many deaths from shock, exposure and hemorrhage. Keogh states that 75 per cent of the deaths that occur after the first twenty-four hours are due to infection.

**Secondary hemorrhage.** Carrel and Chutro are of the opinion that 95 to 98 per cent of secondary hemorrhage is the result of infection. Secondary hemorrhage rarely occurs in the cases where Dakin's solution is used in the beginning, thereby aborting infection. Secondary hemorrhage occurs frequently in all hospitals where infection is rampant. Tournaquets are to be seen hanging at the bedside of many of the infected cases awaiting hemorrhage.

Carrel recognized the necessity for a specific or a technique which would abort infection and control suppuration. The variety of methods and treatments in use was sufficient evidence that all were uncertain and unsatisfactory. The techniques as described by Sir Almoth Wright, Colonel Grey, Professor Rutherford Monson and others have no doubt given better results than methods used before the war, but the fact remains that relatively few of these wounds united by first intention.

**Wounds treated with Bipp paste.** Rutherford Monson (2) states that wound infection has been the great curse of the war and until recently all methods have failed to satisfy the most moderate surgical ambitions. He states that many wounds can be sterilized at once

so that the spread of infection can be checked or limited. His treatment consists of filling the wounds with a paste named Bipp 1 e, bismuth subnitrate 1 ounce by weight iodoform 2 ounces by weight paraffin *quantum sufficit* to make a thick paste. He claims that this dressing requires no change for days or weeks if the patient is free from pain or constitutional disturbance. The further advantages are the lessening of pain, the infrequent change of dressings and rapid healing.

While this treatment has given better results over former methods used by Monson all such wounds heal by *second* intention with free suppuration, while the wounds treated by Carrel's method heal by *first* intention. The same is true with wounds treated by Wright's method and the *salt packs* of Colonel Grey.

*Wright's method of wound treatment.* In certain cases Wright's method has brought about better results than methods used before the war but it neither aborts nor controls infection after it has become well established.

Moynihan (3) states. I do not think Wright's method is applicable in the *worst* cases at least for as I have said, the condition of the soldiers who have received severe wounds is one of exhaustion, with lowered blood pressure, cold extremities, feeble pulse and marked pallor. A few of these patients need infusion before any remedial measures can be attempted and very many suffer from shock in greater or less degree. The introduction of saline tablets in the wound would probably not cause any outflow of serum and if it did it would be a most undesirable result, for fluid cannot then be spared.

#### CARREL DAKIN METHOD

There was a great need for a specific treatment that could be *standardized* throughout the military hospitals. It is necessary for the patient as well as the surgeon to understand that there should be no suppuration and that if Carrel's method is followed infection can be aborted or prevented. The best results are secured by the application of Dakin's solution within the first twenty four hours. Bacteriological examinations reveal the variety of microbial flora, anaerobes and aerobes present in almost all of the wounds. They are usually

small in number during the early stages and localized about the projectile, clothing or other foreign material in the wound. The infection spreads rapidly over the surface of the wound and the microbes are usually too numerous to count after the first thirty six hours. It follows that it is of paramount importance to *sterilize the wounds in the early stages* and that it becomes more difficult to effect sterilization if the microbes are allowed to spread and penetrate. All foreign material should be removed and the antiseptic agent thoroughly employed during the first twenty four hours. It is at times difficult and impossible to remove all foreign material mechanically so we must rely upon some antiseptic solution which will penetrate the cavity and chemically destroy the bacteria without irritating the tissues or producing toxæmia. The solution must be in constant contact with the tissues in order to bring about the destruction of the micro organisms. Dakin's solution (technique of Daufresne) can be used so that from a surgical standpoint, it sterilizes the wound. While these wounds show a very low microbial count on smear they are not, theoretically sterile in that a culture can be secured from 75 per cent of the Carrel treated wounds.

The solution should be made to penetrate all the diverticula of the wound and must be renewed every two hours by installation if complete sterilization is to be obtained. It has the great advantage of being a strong antiseptic, with very slight irritating properties and can be made by a competent chemist or druggist at a minimum cost.

The original Dakin solution was prepared as follows:

- 140 grams dry sodium of carbonate dissolved in 10 litres of tap water to which
- 200 grams chloride of lime (chlorinated lime) is added and
- 40 grams of boric acid

*Preparation of Dakin solution (technique of Daufresne)* as now in use. The solution of sodium hypochlorite for surgical use must be free of caustic alkali. It must only contain 0.45 to 0.50 per cent of hypochlorite. Under 0.45 per cent it is not active enough and above 0.50 per cent it is irritant.

With chloride of lime (bleaching powder) having 25 per cent of active chlorine the quantities of necessary substances to prepare 10 litres of solution are the following

200 grams chloride of lime (bleaching powder) (25 per cent active chlorine)

100 grams sodium carbonate *drv* (soda of Solna 1)

80 grams sodium bicarbonate *drv*

Put into a 1 litre flask the two hundred grams of chloride of lime and five litres of ordinary water shake vigorously for a few minutes and leave in contact for six to twelve hours one night for example (Shake until dissolved — at least until the big pieces are dissolved. Not all the pieces will dissolve large pieces float notice only floating pieces.)

At the same time dissolve in five litres of ordinary cold water the carbonate and bicarbonate of soda.

After leaving from six to twelve hours pour the salt solution in the flask containing the macerated chloride of lime shake vigorously for a few minutes and leave to allow the calcium carbonate to be precipitated. In about one half hour siphon the liquid and filter with a double paper to obtain a good clear liquid which should always be kept in a dark place.

*Titration of chloride of lime (bleaching powder)* Because of the variation of the products now obtained in the market it is necessary to determine the quantity of active chlorine contained in the chloride of lime which is to be used. This must be done in order to employ an exact calculated quantity according to its concentration.

The test is made in the following manner. Take from different parts of the jar a small quantity of bleaching powder to have a medium sample weigh 20 grams of it mix as well as possible in a litre of tap water and leave in contact a few hours. Measure 10 cubic centimeters of the clear liquid and add 20 cubic centimeters of a 10 per cent solution of potassium iodide 2 cubic centimeter of acetic acid or to free all hydrochloric acid then put drop by drop into the mixture a decinormal solution of sodium hyposulphite (2.48 per cent) until decoloration. The number *n* of cubic centimeters of hyposulphite employed

multiplied by 1.775 will give the weight *N* of active chlorine contained in 100 grams of chloride of lime.

The test must be made every time a new product is received. When the result obtained differs more or less than 25 per cent it will be necessary to reduce or enlarge the proportion of the three products contained in the preparation. This can easily be obtained by multiplying each of the three numbers 200 100 80 by the factor  $25/N$  in which *N* represents the weight of the active chlorine per cent of chloride of lime.

*Titration of Dakin solution* Measure 10 cubic centimeters of the solution add 20 cubic centimeters of potassium iodide 1 to 2 cubic centimeters of acetic acid and drop by drop a decinormal solution of sodium hyposulphite until decoloration. The number of cubic centimeters used multiplied by 0.03725 will give the weight of hypochlorite of soda contained in 100 cubic centimeters of the solution.

Never heat the solution and if in case of urgency one is obliged to resort to titration of chloride of lime in a mortar only employ water never salt solution.

*Test of the alkalinity of Dakin solution* To differentiate easily the solution obtained by this process from the commercial hypochlorites pour into a glass about 20 cubic centimeters of the solution and drop on the surface of liquid a few centigrams of phenolphthalein in powder.

The correct solution does not give any coloration while Lebarrague's solution and *eau de Javel* will give an intense red color which shows in the last two solutions existence of free caustic alkali.

The stock solution should be kept in blue or brown colored bottles well corked.

*Difficulties in making Dakin solution* On account of the unstableness of bleaching lime which varies in its chlorine content from 15 to 37 per cent active chlorine some difficulty has been encountered in making the solution.

Much of the sodium bicarbonate used today is composed largely of sodium carbonate thus is one of the causes for the difficulty of neutralizing the solution. If the solution is alkaline or caustic it will burn the skin and irritate the tissues. It must be neutralized with sodium

bicarbonate and should be frequently and thoroughly tested on account of its unstableness and tendency to become caustic

There is a difference between the solution of Dakin as originally made and the hypochlorite solution technique of Dausfresne. Dakin's original solution contained 0.5 to 0.6 per cent sodium hypochlorite. The solution modified by Dausfresne does not contain boric acid but contains between 0.45 and 0.50 per cent hypochlorite. It is very important that the solution should not be over 0.50 per cent if it is it will be too caustic, and if below 0.45 per cent too weak.

Many of the so called Dakin solutions are not prepared in accordance with the formula of the name they bear and as a result the solution has been condemned where some other solution has been used in the name of Dakin.

*Chloramine (Boots) and chlorazene (Abbott) (para toluene sodium sulphochloramide)*. An active antiseptic containing chemically combined chlorine which is quite stable and non-irritating but when brought in contact with proteins and similar cell constituents containing basic NH groups it acts as a chlorinating agent losing its chlorine to the basic substances and thereby asserting its antiseptic action as needed. Its advantages are its free solubility in water.

It is a very stable substance the aqueous solutions showing no tendency to decompose after several months. It does not precipitate or coagulate proteins. It is non-toxic and non-irritating having an intense germicidal action. While they are entirely different substances they resemble very much the hypochlorites in many respects.

Dakin is inclined to think that the same results may be obtained with chlorazene as with the hypochlorites. The writer however has had no personal experience with chlorazene. The results quoted in this paper are due to the use of hypochlorites. Chlorazene will no doubt be found to be more satisfactory where they do not have the proper facilities for making Dakin's solution and also in hot climates on account of its greater stability.

*The antiseptic action of hypochlorites*. Berthollet a French chemist in 1788 obtained a

bleaching and disinfecting liquid by the action of chlorine upon aqueous alkali. Ballard discovered hypochlorous acid in 1834. Percy at the Javel works near Paris in 1792 commercially made sodium hypochlorite by pressing chlorine into crude potashes. The product was used as a disinfectant and was sold as *eau de Javel*. Semmelweis stamped out an epidemic of puerperal fever in Vienna in 1846 by the use of bleaching powder. The great difficulty has been that the hypochlorites in solution rapidly lose their strength by decomposition and have been too caustic for surgical use. It has been found that *hypochlorous acid* is a more active antiseptic than its salts. Dakin (4) set about to correct the objectionable qualities of the hypochlorite solutions. Professor J. Lorrain Smith and Dakin worked simultaneously each striving to prepare a satisfactory hypochlorite antiseptic which included the main properties of the hypochlorites discovered by French chemists many years before.

Lorrain Smith (5) and his associates have aimed at a more or less complete liberation of free hypochlorous acid from chloride of lime by the addition of an equal weight of boric acid. Smith's preparation is known as *eusol*.

1. 25 grams of Euprid (equal parts of commercial bleaching powder and boric acid intimately mixed and ground in a mortar) are shaken up with 1 litre of water and allowed to stand for a few hours then filtered through cloth or filter paper. This mixture should be kept in a closely stoppered bottle and not exposed to light.
2. To 1 litre of water add 12.5 grams bleaching powder shake vigorously then add 12.5 grams boric acid powder and shake again. Allow to stand for some hours preferably over night then filter off and the clear solution is ready for use.

This solution contains

	Per cent
Hypochlorous acid	0.54
Calcium borate	1.28
Calcium chloride	0.17

Total

1.99

The amount of free hypochlorous acid in Dakin's mixture is smaller than in *essol* (Smith's solution) and can be used continuously without irritation.

*Bactericidal properties of hypochlorites*—Ridall (6) using carbolic acid as a standard expresses the germicidal power of hypochlorites as follows: Carbolic acid 100 hypochlorites 14 600 to 22 000.

Andrews and Orton (7) found that a suspension of *staphylococcus pyogenes aureus* in pure distilled water was sterilized in one minute in the presence of one part hypochlorous acid in 100 000. In a suspension in broth 1 to 5 000 did not but 1 in 3 000 did kill the *staphylococcus* in thirty minutes. They concluded that the activity of pure acid was greatly diminished in the presence of organic matter.

As a result of a series of exhaustive experiments Smith states that hypochlorous acid 0.5 per cent never completely sterilized the tissue (adult colon) when applied for thirty minutes. In that time however 3.2 per cent hypochlorous acid gave complete sterilization with adult colon. In twenty-four hours at room temperature 0.5 per cent hypochlorous acid did produce complete sterilization though not invariably and even 0.25 per cent gave this result.

In a series of bacteriological experiments Smith with cultures of organisms on artificial media showed that 0.5 per cent hypochlorous acid in every case killed the organisms with only two minutes exposure. The organisms used were *bacillus coli*, *staphylococcus pyogenes aureus*, *bacillus anthracis*. Wenker's solutions of hypochlorous acid than 0.5 per cent failed to kill anthrax spores in three minutes at room temperature. 0.5 per cent solution killed anthrax spores as readily as the non-sporing organisms.

*Mode of action of hypochlorites*—Dakin states that he has been unable to find any evidence to support the theory that the antiseptic action of hypochlorous acid is due to its decomposition in the presence of organic matter with the liberation of oxygen. When strong hypochlorite solutions are added to animal tissues an evolution of chlorine rather than oxygen occurs. It appears that when

hypochlorites act upon organic matter of bacterial or other origin some of the (NH) groups of the proteins are converted into (NCl) groups. The products thus formed belong to the group of chloramines; these chloramines have been found to possess the same antiseptic action as the original hypochlorite—and it appears more probable that the antiseptic action of the hypochlorites is conditioned by the formation of these chloramines rather than by the decomposition with liberation of oxygen. The hypochlorites no doubt have a double action: direct bactericidal effect and the hypersensitizing effect producing a flow of lymph from the surface of the wound and at the same time having intense antiseptic properties without damage to the tissues and entire absence of toxic absorption. Suppuration rapidly disappears, the discharge losing its fetor, takes on a serous character.

The rapid disappearance of all pus, necrotic dead or decomposed material within five to seven days is the most remarkable effect produced. The granulations take on a healthy glow resembling very much the gross appearance of beefsteak; no other wounds or granulations present a similar appearance. As the infection is brought under control the discharge becomes clean and free from odors. The question that naturally arises is: Can the same results be brought about by Carrel's technique with antiseptics other than Dakin's solution? DePage has shown beyond any question of a doubt that certain recessions in the bacterial chart do occur but that Dakin's solution is the only antiseptic that will keep a wound aseptic and permit suture.

To be successful one must follow the technique of Carrel. Dakin's solution represents but 20 per cent of the cure and the technique of Carrel represents 80 per cent. The method is not one of drainage or multiple incisions; it is the opposite of this procedure. The success of the treatment is dependent upon the thoroughness with which it is applied and the care given to the most minute details of the technique. The attending surgeon as well as his assistants and nurses should have a mutual understanding with reference to this treatment in order to bring about technical

perfection. Much of the success of this treatment depends upon the intelligence and thoroughness with which it is applied by the nursing organization. They should receive special training in the application of the technique. It is not always possible to give the treatment which is most to be desired in wounds of war as one frequently encounters obstacles which prevent the carrying out of details.

1 *First dressings at the trenches at the advance dressing stations and the first aid dressing stations.* The area surrounding the wound should be disinfected with tincture of iodine and an injection of Dakin's solution in the wound, if it is small or narrow should be made. If it is wide and freely open a gauze pack which is saturated with Dakin's solution should be applied. The prognosis is materially aided if this dressing is used.

2 *Dressing at the military base hospitals or civilian hospitals.* If the wounds are extensive or conditions warrant, a general anesthetic should be administered and the operating field prepared in the usual way. A free incision and thorough exploration for foreign bodies of all wounds should be made at the earliest possible opportunity. The foreign bodies are localized with the fluoroscope or with stereoscopic skiagrams. All bleeding points should be ligated. The shell tract should be freely opened and all devitalized tissue excised. The Carrel tubes should be carried to the bottom of the wound and gauze loosely placed between them. Before completing the final dressing the solution can be injected in the wound to ascertain the amount of solution necessary to fill the cavity completely and whether or not it is reaching all parts.

The final dressing consists of a gauze pad saturated with Dakin's solution over which a large pad of non absorbent cotton which completely envelops the extremity is placed. Turkish toweling can be used instead of non absorbent gauze pads if desired.

#### DESCRIPTION OF APPARATUS AND METHOD OF APPLICATION OF TUBES

To carry out accurately the Carrel technique it is absolutely necessary to employ the

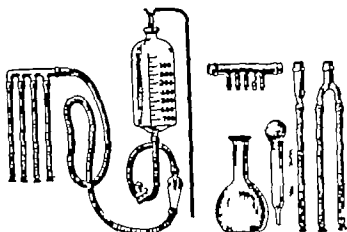


Fig. 1 Carrel's apparatus for administering Dakin's solution

special apparatus which has been designed for this purpose. Many of the failures have been due to the incompleteness of the standard equipment and an attempt to modify it (Fig. 1).

The vessel containing the solution somewhat resembles a Kelly infusion bottle in shape, being graduated in cubic centimeters, so that the amount of solution injected in the wound can be accurately measured. The neck of the container is closed with a rubber cork through which a glass thistle is passed. The bulbous portion of the thistle is filled with sterile cotton. The thistle serves the double purpose of preventing loss of chlorine from the solution and allowing sufficient atmospheric pressure to permit a free flow of the solution from the container into the tube. The projection at the bottom of the container to which the tube is fastened which carries the solution into the distributor is a continuation of the bottom of the container itself and allows complete drainage from the bottle. Rubber tubing 1 centimeter outside diameter carries the solution from the container to the distributor. A glass drip the lumen of which is 6 millimeters in diameter is inserted in the main tube between the outlet of the container and the distributor. This drip indicates the rate and amount of solution flowing from the container. The glass distributors are made so that the inlet can easily be slipped into the rubber tubing from the container. These distributors are made in multiples having from one to five outlets to which the Carrel tubes are attached. The outlets from the distribu-



tors should be made so as to allow the easy attachment of the Carrel tubes. The Carrel rubber tubes are approximately 15 to 25 centimeters long, having a diameter of 5 millimeters, the inside lumen of which is 3 millimeters, giving a 1 millimeter wall for the tube. They should be made of pure rubber so that the end of the tube can easily be tied off with either Pagenstecher linen or strong silk. Rubber tubing containing fabric or catheters will not suffice because of the difficulty in closing the end and the destructive action of the hypochlorite on the fabric.

Beginning from the distal end, a series of small holes, approximately one half millimeter in diameter, is pierced at intervals of one half centimeter, six, eight, ten or twelve perforations are usually sufficient and are made with a specially designed punch (similar to a leather punch). Both sides of the tube are pierced with one punch, the tube is then turned on its axis to a right angle and the process alternately repeated, thus staggering the perforations. Extreme care must be exercised to remove the rubber plugs made by the punch so that there will be no obstruction to the flow of solution. These plugs can readily be removed by stretching the rubber. The number of tubes to be used must be decided by the size and depth of the wound. They should be inserted so that all parts of the wound are constantly bathed with the solution. To prevent the tubes from bunching in the wound, strips of gauze are loosely placed between them. The gauze serves the double purpose of keeping the tubes *in situ* and retaining the solution. Gauze should never be packed tightly in the wound. A gauze compress is gently placed over the tubes and the dressing completed by covering with turkish toweling. The dressing is fixed with a bandage, care being taken not to constrict the tubes, but fixing them to prevent displacement.

The bleaching properties of the hypochlorite rapidly destroy the cotton fabrics. In the severe cases, a large pad of non-absorbent cotton which completely envelops the extremity can be used. Non-absorbent cotton is used to prevent the taking up of the Dakin solution from the wound. This dressing should be

approximately 3 centimeters in thickness and is made in various sizes and shapes.

For superficial wounds the Carrel tubes are covered with turkish toweling, extending from the distal end to a point just beyond the proximal perforation. These tubes remain in position without slipping over the tissues and keep the wound areas sufficiently bathed. Strips of gauze should then be placed between the turkish toweling tubes, this tends to keep them in position and also retains the solution.

The graduated container should be elevated not more than three feet above the patient. A stop cock is placed distal to the outlet of the container. The solution should be allowed to flow into the wound by releasing the stop cock, allowing just sufficient solution to enter the wound to fill it and not overflow. The wounds are linked or puddled with the solution. Where pain is experienced the container should be lowered, the pain is due either to pressure or the causticity of the solution.

Emphasis must be laid upon the fact that the most effective method is the intermittent installation every two hours, day and night, and not constant irrigation. The amount of solution to be injected can be prescribed by the surgeon in charge. However, the attending nurses soon learn by experience just how much solution is necessary.

*The redressing.* The wounds should be redressed daily, every aseptic precaution should be scrupulously exercised. The hands should at no time come in contact with the wound, the entire dressing being completed with either tissue forceps or hemostats. Re-infection of a sterilized wound can easily be caused by errors of technique. The skin surrounding the wound should be thoroughly cleansed with ether which dissolves the vase line from the skin. This is followed by a sponging of the skin with cotton using a neutral sodium oleate solution, which is a very satisfactory cleansing solution, it is neutral and non-irritating. The wound is then gently sponged with sodium oleate solution, this being followed by a sponging with Dakin's solution. The sponging process removes the wound secretion, necrotic tissue and other debris. The edges of the wound are



Fig. 2. Hernia cerebri reduced with Carrel's method. Loss of bone substance in skull replaced by bone graft from crest of tibia. Perfect functional result. (Courtesy of Professors Goese and Chutro, Hospital Buffon, Paris.)



Fig. 3. Shell wound of chest and arm. Wounds sustained eighteen days after admission Union by first intention. Perfect recovery. (Courtesy Professor DePage, Hospital Ocean, Ixanne, Belgium.)

protected with gauze which is saturated with vaseline. The gauze is prepared by immersing suitable lengths of No. 4 bandage gauze in yellow liquid vaseline which is sterilized and allowed to cool before using. By following this process the vaseline gauze is easily applied.

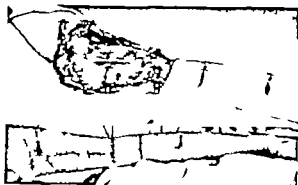
The Carrel tubes are introduced in the wound, the ends attached to the distributors and the dressing completed as described. In emergency cases dressings can be delayed two or three days, providing the installation of the solution is kept up. It is absolutely necessary that a free and open incision be used to permit the easy introduction of the tubes and gauze in the wound.

#### REASON FOR FAILURES IN THE USE OF THE CARREL METHOD

It is unfortunate but true that all scientific advancements in the medical profession have been received with skepticism and it has taken years for them to be generally accepted. As

a result of this attitude there were but six hospitals in Europe on September 1, 1916, using the Carrel method properly. The failure to recognize and put this method into practice has been the cause of a tremendous loss of life, an untold number of amputations, frightful deformities, disfigurements and permanent disabilities, the vast majority of which are now beyond surgical assistance.

It has been proved beyond any question of doubt that Carrel's method of wound sterilization with Dakin's solution is a specific. Carrel and Dakin place great stress upon the fact that it is necessary to spend at least two weeks in observation of the method before the details can be mastered. Failure to understand the details of the technique has been the cause of many of the unsatisfactory results. Certain individuals have condemned the method upon theoretical grounds without having made any investigation or without understanding the first principles of the method. They do not want to believe there is



146 Still better still  
Went to the Carrel method  
treatment of the wound and  
the result was permanent  
Curtis of the D. H. I. O. B. L.

anything new they are satisfied. The time is at hand when the medical profession may be held responsible for their failure to accept



Fig 6 (also Still and Gould and Miller) of upper third of humerus and distal end of ulnar humerus. Operation on the front of the infection and suppurative wound. The distal end of the ulna was removed and the bone graft from crest of tibia. The result was a permanent cure. (Curtis, Jones and Chutro)

Fig 7. Infection of knee joint. Operation on the front of the infection. The result was a permanent cure. (Curtis, Jones and Chutro)



Fig 8. Sterilized and treated the wound. The result was a permanent cure. (Curtis, Jones and Chutro)

as scientific and in the fact means the saving of an enormous number of cripples and lies

#### HOW TO ABOLISH INFECTION AFTER IT HAS BECOME FULLY ESTABLISHED

Certain opponents to the Carrel method were willing to concede that infection could be sterilized but were unwilling to concede its efficacy after infection had been fully established. However Chutro, Gosz and Fusher in a very large series of cases have been able to effect infection by carrying out in detail Carrel principles of technique.

#### THE ABORTIVE TREATMENT OF INFECTED WOUNDS

Experience has shown that the infected wound of war treated by use of tincture of iodine, Wright's solution, bichloride of mercury, the carbolic groups and countless other antiseptics fail to prevent wound infection. The vast majority of deaths, amputations, disabilities and complications are due to infection therefore we must control infection.

In spite of the absolute failure of all former methods to abort infection no new method was devised that was satisfactory. The antiseptics used heretofore have been either too

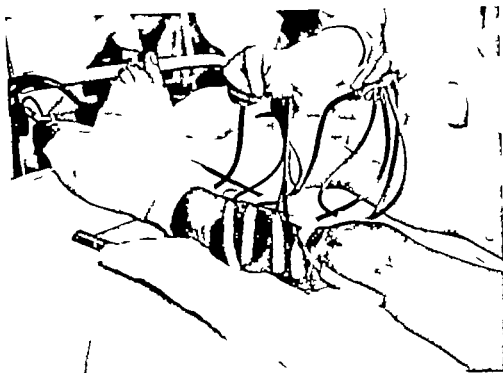


FIG. 5. Compound comminuted fracture of leg, labeled A. An incision on arm at 1 inch into a sterile extension of the tube with Carrel's tubes in position. Free irrigation on admission. Dressing had not been changed for five days previous to admission to hospital. Infection under control in five days. The functional result secured is far superior to an artificial leg. (Courtesy Professors Gosse and Clément.)

feebly bactericidal or too irritating and toxic for the tissues. By controlling infection at the beginning one avoids septicaemia, suppuration and their complications. In other words an ounce of prevention is worth a pound of cure.

It is acknowledged that appendicitis operated upon within the first twenty-four hours is usually followed by cure, but if the operation is deferred twenty-four to thirty-six hours the end results are very uncertain. The same principles of industrial and civil surgery apply to wounds received in war. The abortive treatment to be effective should be started as soon as possible after the wound is received.

Chemical sterilization of a wound can only be carried out with a strong germicide which is non-toxic and a non-irritating antiseptic. If the solution penetrates all the sinuses and diverticula it must be renewed every two hours in order to effect complete sterilization.

#### SUTURE AND CICATRIZATION

If the clinical appearance of the wound and the bacteriological verification indicate that

the wound may be sutured the edges are incised and if granulation tissue is present it is removed and the wound sutured. Lateral incisions are made if the tension is too great so that the edges of the wound can be brought together without tension. If there is a great loss of tissue and it is found impossible to suture the wounds can be laced together or pulled together with adhesive plaster strips to be followed later by plastic operation if indicated.

Of the wounds treated at Compiègne by the Carrel method 99 per cent have united by first intention with practically no reaction either along the line of incision or at the stitches. There is no drainage from the wound — Gibson has very aptly expressed their appearance as resembling very much the appearance of postmortem wounds.

#### THE TREATMENT OF ACUTE AND CHRONIC OSTEOMYELITIS AND EPIPHYSITIS BONE AND JOINT TUBERCULOSIS

A free incision should be made and if any necrotic tissue is present should be gently





FIG. 1. Shell and of face and lower jaw on admission. Middle picture three weeks later. Picture at right shows no facial deformity. (Courtesy of Prof. Dr. DePage)

Two rubber tubes which are perforated throughout their entire uterine length are carried into the uterus to the fundus. Through the central opening in the pessary after the introducer has been removed ribbon or bandage gauze is lightly carried into the uterus by a uterine packer. The gauze serves the double purpose of holding the tubes in position and also retains the solution but should not be packed tightly into the uterus. The gauze can be removed daily if necessary.

Rubber heetings attached to the external orifice of the self-retaining pessary at the external os and project from the vagina. The heetings completely envelop the rubber tubes and the central gauze drain which emerges through the central opening of the pessary. The heetings also protect the vagina from irritation.

The rubber tubes are attached to the distributor which in turn is attached to the container by a single rubber tube. The tubes should be changed every second or third day as indicated.

The pessaries are made in four different sizes as the uterus contracts. A smaller size pessary should be introduced. The vagina should be protected with yellow vaseline and

if it is necessary to hold the pessary in position the cul de sac can be gently packed with gauze. The Dakin solution should be injected in the uterus every hour or every half hour if necessary. The amount to be injected depends upon the size of the uterus and the pathological conditions existing. Extreme care should be taken to prevent the injection of the solution through the fallopian tubes into the abdominal cavity. A large pad of absorbent cotton and gauze applied to the vulva.

These pessaries with certain modification of technique can be used for the treatment of empyema and urinary cystitis.

Ureteral catheterization will facilitate the sterilization of the bladder by keeping it free from urine allowing the Dakin solution to bathe the bladder wall. A modification of this technique can be used for the gall bladder where conditions are indicative of this procedure.

The basic principles of the method should be kept in mind at all times regardless of the location of the infection.

The Carrel method is indicated in the treatment of rectal infection, fungating carcinoma, tuberculosis of the joint and bone.

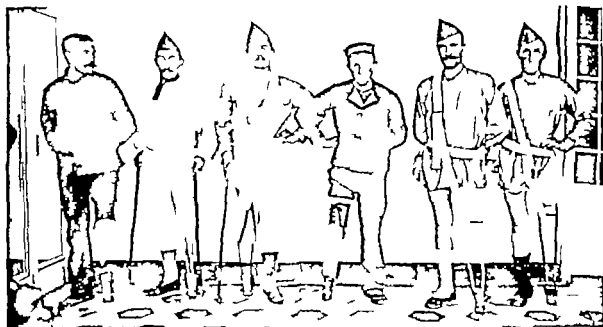




Fig. 12. (left) Double traumatic amputation both legs below knee, extensive sloughing of tissues with infection. (right) Carrel tubes emerging from dressing attached to four wall distributor. Each container of Dakin solution is attached. (Author's case.)

centimeters of fetid pus escaped when the peritoneum was incised. A gangrenous appendix perforated near the base was found lying fairly free in the large abscess cavity and was removed. The cavity was sponged free of pus and two Carrel installation tubes were inserted. Two silk worm gut sutures, which included only skin and the external oblique were inserted, one at each end of the incision. Ten cubic centimeters of Dakin solution were installed into each tube at two hour intervals for the first twenty four hours and at three hour intervals for the succeeding period of convalescence. On October 28 the patient's temperature dropped to normal. There was a slight elevation (100.00) on each of the two succeeding days but from the 30th the temperature remained normal. The abscess cavity and the abdominal incision closed rapidly and on November 18 twenty three days after operation the patient returned to work.

**CASE 2.** C. M. B. white American female, age 15, school girl. Admitted to Finsley Hospital November 16, 1916 at 11:00 a.m. Temperature 101, pulse 134, respiration 32, white blood corpuscles 18,000.

**History.** Patient had been violently ill for five days with intense pain which began in right side but rapidly spread over entire abdomen. The family physician had made a diagnosis of typhoid fever.

**Physical examination.** Showed a greatly distended and markedly rigid abdomen. The patient's expression was anxious and all indications pointed to a general peritonitis.

**Diagnosis.** Probably perforated appendix with general peritonitis.

**Operation.** 1:00 p.m. November 11, ether anesthesia. Right rectus incision. On incision of the abdomen a large quantity of pus escaped. The parietal and visceral peritoneum showed an advanced peritonitis with the presence of a large amount of shaggy exudate. The appendix was lying free in the abdomen was gangrenous and perforated near the base.

The appendix was removed as rapidly as possible but with some difficulty. The abdominal cavity was sponged fairly free of pus and a counter incision was made at McBurney's point on the left side.

Two cigarette drains were inserted into the pelvis on either side and in addition six Carrel installation tubes were inserted, three on each side distributed over the cavity. No closure of incisions was made.

At two hour intervals throughout the first twenty four hours 10 cubic centimeters of Dakin solution were installed into each tube. From the second to the fourth day the installation was made at three hour intervals. From the fourth day to the seventh day at six hour intervals.

The patient's improvement within twelve hours after operation was most marked and within three days her temperature reached normal where it remained. Convalescence was uninterrupted and on the twenty seventh day the patient was discharged from the hospital as cured, the abdominal wounds being entirely closed.

**CASE 3.** A. D. N. white American male, age 21, craneman. Admitted to Finsley Hospital December 16, 1916 at 1:00 p.m. Temperature



Fig. 13. Compound fracture, great loss of superficial tissues, periosteum stripped free from the tibia. Method of application (Turkish) to eling covered Carrel tubes. (Author's case.)



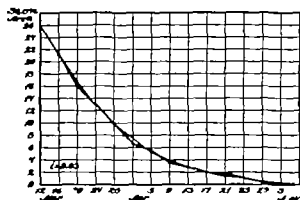


Fig. 7 Wound cicatrization chart

tive surfaces by the time which has elapsed between the two observations. The value of the rate of cicatrization in its relation to the area is obtained by the formula 5. A curve was obtained by carrying the area in square centimeters in ordinates and the time in days in abscissae.

Thus it is possible to ascertain daily in square centimeters the size of the wound, the size of the cicatrix and the velocity of the process of repair. By means of this technique the relations which exist between the size of the wound and the rate of cicatrization and the respective value of contraction and of epidermization in the process of repair can be estimated. The curves representing the progress of cicatrization assume a geometric appearance so that the relation between the size of a wound and the rate of repair may be expressed mathematically. The regularity of cicatrization depends in a large measure on the bacteriological condition of the wound. The more aseptic the wound the more regular is the curve of cicatrization. After a wound is chemically sterilized the rate of cicatrization increases.

When an aseptic or slightly infected wound is infected the curve of cicatrization becomes horizontal or inflected upward showing that arrest or retrogression of the repair occurs. Some of the sterile wounds may become infected while under observation.

As soon as bacteria appear the process of repair is retarded and sometimes stops. However infection when it is of short duration has no marked disturbing influence on the curve representing the cicatrization of the wound. As soon as normal conditions are established the progress of cicatrization is hastened. After a period of inactivity an automatic mechanism seems to accelerate the healing progress. Cicatrization is always more rapid in the beginning than at the end of the period of repair. The absolute value of the rate of cicatrization that is the surface lost by the wound in twenty-four hours depends mainly on the size of the wound. Wounds of 100 to 50 square centimeters decrease to four to seven square centimeters in twenty-four hours while the daily diminution of wounds from

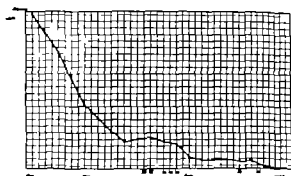


Fig. 8 Wound cicatrization chart. Wound slightly infected from December 7 to January 14. On January 4 the infection caused the curve to become regular.

ten to two square centimeters is but one to ten square centimeters. It is evident that the rate of repair is proportional to the size of the wound but the rate of cicatrization is not exactly proportional to the size.

**Conclusions on wound cicatrization.** As a result of exhaustive experiments Carrel, Hartman and Du Nouy arrive at the following conclusions:

1. A method for measuring the area of a wound not geometric in form is described.

2. The rate of cicatrization of a wound is greater at the beginning than at the end of the period of repair. It depends on the area rather than on the age of the wound. There is a constant relation between the size of a wound and the rate of cicatrization; the larger the wound the greater is the rate of cicatrization. Two wounds of different size have tendency to become equal.

3. The rate is proportional to the area but diminishes less rapidly than the area.

4. The process of contraction is the more important factor in the repair of a wound. Epidermization completes the work of contraction after the wound is healed; the cicatrix as a rule expands.

5. The curve representing the diminution of the size of an aseptic wound while it cicatrizes is regular and geometric.

6. The principal point consisted in determining by means of an equation a constant or index characterizing each wound. The calculation had to be made for each patient, for each wound and required two observations four days apart.

The index having proved to be a continuous function of the size of the wound and the age of the patient of the form  $S \times I = K$ , where  $S$  is the area,  $I$  the index, a decimal exponent and  $K$  a constant, it was then possible to draw a chart by means of which this index  $I$  could be obtained without calculation. The advantage of the new way of determining the index is above all that this index is a general average normal index and no longer an

individual index. Hence the differences between the observed rate of cicatrization of man and the normal rate may give some indication of the general state of the patient. Another advantage, is that the determination of the index is no longer controlled by the temporary accidents which may happen between the two observations of  $S$  and  $S'$ .

It may be stated that under given conditions of asepsis and dressing the area cicatrized in a day is directly proportional to the size of the wound to the square root of its age and to the relation between the rate of cicatrization and the square root of the age of the wound at the time of observation.

The cicatrization of sterile wounds may be studied in the same way as ordinary physicochemical phenomenon. It is possible therefore to express the law of cicatrization by a mathematical equation so soon as an accurate measure of the wound can be obtained. By means of the equation a curve is obtained which represents the theoretical evolution of the cicatrization of a wound. This curve being an expression of what should happen on a normal wound healing aseptically on a normal man is a daily point of comparison to what appears actually on the observed wound and allows one to study accurately the fluctuations of cicatrization on a given individual and the action of different dressings and antiseptic substances.

**Results** DePage reports 137 sutures as follows

a 112 complete successes. In these cases re union was perfect on the whole extent of the section without there being the least inflammatory reaction.

b 23 partial result. In this category are placed two cases in which the stitches came loose either in consequence of necrosis of the section or of too strong tension or on account of slight suppuration which resulted from an insufficiently established asepsis. This result instead of detracting from the value of bacteriological verification only confirms its utility.

c 2 failures. One in the leg with exaggerated tension of the skin. This case should not have been sutured owing to tension and it was afterward treated by strips of adhesive plaster and rapidly recovered. The other failure was a fracture of the radius with a large wound and tension of the skin. It was necessary to reopen the wound the next day on account of the recurrence of infection in the soft tissues. The wound was rapidly sterilized afterwards and the open fields completely closed within a few days. The fracture was cured as if it had been a simple one.

The nature of these wounds was as follows

a 102 wounds of the soft tissues

b 6 articular wounds of the skin of the knee and left fibula open. 5 complete successes and one partial result.

c 12 wounds of amputation stumps. 10 complete successes and two partial.

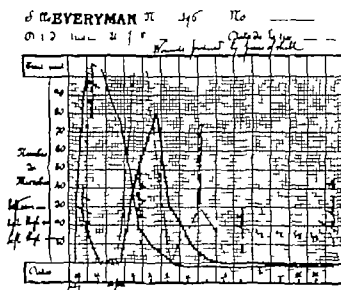


Fig 19 Bacteria chart showing curve of 3 different wounds (Service of Professor Delage)

In conclusion DePage states that since July 1 1916 they have had under treatment in their hospital 103 fractures. At the time of my visit to him at LaPanne August 20 1916 there were 80 cases of compound fractures undergoing treatment not one was suppurating and all were as healthy as simple fractures.

Similar results to those of DePage were secured by Dr H M Lyle at the Hospital Depew Chateau Anel Oise.

Drs Dehelly and Dumas (11) report the treatment of 155 wounds from shell splinter grenade splinters bomb and mine splinters. Wounds caused by bullets are not included in these statistics and of these 155 wounds 135 were closed i.e. 84.7 per cent. Out of the 135 closed wounds 121 closed before the twelfth day i.e. 89.7 per cent. 119 or 88.25 per cent were healed up in less than 30 days and of these 155 wounds 25 were complicated by fractures. Of these 25 cases 22 were closed and 18 were healed in less than thirty days. Similar results have been secured by Pozzi, Tuffier and Uffoltz (12).

**Chloramine or chlorazene paste** Carrel has made a number of exhaustive experiments with chloramine paste in which sodium stearate is used as a base. This paste should only be used for superficial wounds. Considerable difficulty was experienced in securing a paste which would

give up the chloramine to the tissues. The general appearance of wounds paste treated is totally different from those treated by the solution of Dakin but bacteriological examinations show that the results obtained are identical. The paste is used to simplify the method of dressing.

Frequently wounds are found reinfected from skin infections so that care must be exercised to prevent contamination to the wound from this source. Every precaution should also be taken to prevent infection occurring at time of operations and dressings.

#### CONTRA INDICATIONS

It should never be forgotten that the solution must not be heated. It should never be applied or used in the eye or intravenously because of its hemolytic action. It should never be used intravenously. It should be kept in a cool place free from exposure to light. It should never come in contact with alcohol.

#### ADVANTAGES

It has been demonstrated in the treatment which I have had the honor of describing that the great majority of wounds can be closed by suture and without suppuration. The stay of the wounded in the hospital and period of convalescence is greatly shortened and many now leave in four to six weeks who would have required treatment from three to six months under former methods. All complications such as atrophies ankylosis adhesions septicæmia and amputations are minimized the mortality rate is also greatly reduced.

Professor Chutro (service of Gosse) gives us this startling report that he is now doing one amputation for sepsis and hemorrhage where formerly *ten* were necessary and there is but one death where formerly there were *ten*. Many cases which were labeled amputate on arrival at the front have been saved from amputation by Chutro.

These statements bear investigation and because of their humanitarian and economic features should be given deep consideration.

#### CONCLUSIONS

1 Infection can be aborted if the treatment is begun within the first twenty four hour.

2 Suppuration when well established can be controlled if the focus can be reached.

3 The success of the treatment is dependent upon the perfection of the Carrel technique and the acceptance of all the detail.

4 The effect of Dakin's solution is entirely local there being no danger of toxæmia from absorption regardless of the amount used.

5 Carrel's technique using Dakin's solution is a specific against infection of wounds.

6 Deaver's dictum. He who drains well does surgery well must be revised to— He who does Carrel well does surgery well.

I wish to express my sincere thanks and grateful appreciation to the United States Steel Corporation and the Rockefeller Institute for their generous assistance and co-operation making it possible for me to study at first hand the treatment of wounds of war and also Dr Carrel Professors DePage Pozzi Tuslier and Chutro for the kind interest and help which enabled me to obtain knowledge of their wound treatment. The results obtained by them speak more eloquently than words of what is being accomplished by their efforts. I wish to take this opportunity of expressing my deep gratitude to Sir Arbuthnot Lane Sir Berkley Moynihan Sir Alfred Keogh Sir Wilham Osler and Mr E. M. Corner for their many courtesies.

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THE INDICATIONS FOR CHOLECYSTECTOMY<sup>1</sup>

By FRED B LUND M D F A C S Boston

I BEGIN to think I must have been in practice several years. Just twenty four years ago I had the pleasure of assisting Dr John Homans at his first cholecystostomy *Vixere fortes ante Agememnona* which means there were good surgeons before the Mayos came into prominence and Dr Homans was one of the best of his time. The operation was then such a novelty that he astonished the bystanders by stating in an offhand way that he had just done one of those operations the day before. Their astonishment that two gall stone operations could be done on two consecutive days by any one surgeon was relieved by Dr Homans' confession that the operation of the day before had been done for practice in the dissecting room. The gall bladder was fastened to the abdominal wall by interrupted sutures. I remember how a few days later a country doctor—I mean, a visiting physician from the rural districts—was invited to put his finger into the gall bladder and feel how empty it was and did so with such enthusiasm that he tore the bladder partly off the abdominal wall and I had to sew it on again. Such were the crude and early methods of those days when the mortality was high the operation usually advised and practiced only as a last resort and immediate relief from acute symptoms given more consideration than permanent cure.

From a time like that when the operation was a rarity to the present when gall stone operations are performed by every surgeon of experience by the hundreds and in the great clinics by the thousands when the technique has been correspondingly improved and the mortality reduced is but an example of what has been accomplished in our lifetime in one single field of surgery. The advances in other fields are quite as wonderful.

As we progressed from the gall bladder to the common duct cases—and we all remember the weird appliances devised for incising

the common duct hammers balloons etc—and the technique became familiar more extensive operations were entered upon and the removal of the gall bladder began to be done. We became familiar through the finding of gall stones at laparotomies for other causes with the phenomenon of gall stones without symptoms just as we had learned about symptoms without gall stones by the simple method of operating for gall stones and not finding them. We have gradually come now to regard cholecystitis or infective inflammation of the gall bladder as more important than the presence of stones as usually antecedent to stone formation and fundamental. The cholecystitis is primary and the stone formation though of great and often overshadowing importance secondary.

In regard to operative treatment as time has gone on we have learned something by our failures among other things that gall stones may recur after cholecystostomy and that cancer of the gall bladder may ensue upon this operation. In an experience of 347 operations upon the gall bladder and bile ducts I have had 3 cases in which stones have reformed after removal and 3 cases of cancer of the gall bladder developing after the removal of stones.

We have also learned that in certain large clinics the experiences of the operators of which have been freely given to us and the laboriously compiled statistics of which have been of the greatest value—Mayo Finney etc—symptomatic cure after cholecystostomy has been not more than 75 per cent therefore 25 per cent still had symptoms.

Fifteen or twenty years ago some of the bolder spirits among us advocated the removal of the gall bladder almost as a routine i.e. where the conditions of the patient or anatomical conditions did not render it dangerous. However the majority of surgeons were against this procedure and upon that side it is to be noted the great influence of the Mayo clinic was thrown. The reason

for the preservation of the gall bladder was the supposed need for the bile drainage through the tube tied in it to relieve the infection of the ducts. The same clinic and others of influence and importance have in recent years so changed in practice as to perform cholecystectomy in 90 per cent of their cases of gall bladder disease. Yet other surgeons are opposed to cholecystectomy and what is of greater interest men of great experience and reputation in response to questions give very different indications for the performance of cholecystectomy (9) so that to those of lesser experience seeking to learn the true state of things it is to say the least difficult to arrive at a decision. It is to try to clear up the considerations which must influence our decision in any given case that this paper is written.

The operation of cholecystotomy is so safe and simple that if it were always curative there would be no question of further procedure but it is not and cannot always be curative in the very nature of things and for this reason conditions become often complex and many varying considerations must often influence us in any given case. If for instance in cholecystitis the infection takes place through the blood stream and the bacteria are situated in the walls of the gall bladder then cholecystectomy is the only certain method of cure but before advocating it in all cases we must meet the objection that in removing the gall bladder we forever deprive ourselves of the easy and safe surface drainage which is so often the only method of cure of certain of the complications of gall bladder disease notably chronic pancreatitis with jaundice.

To begin with one must admit that all cases of cholecystitis with or without stones are previously cases of infection. The infection may be due to typhoid bacilli staphylococci and streptococci or even influenza bacilli—all of which have been found in the bile and many in the interior of gall stones forming the nuclei thereof. It is indisputable that bacteria may reach the interior of the gall bladder by the duct route from the working up of stagnant bile from an infected duodenum in duodenal ulcer etc but there is every

reason to believe that this route of infection is rare. The oblique entrance of the common duct as it passes between the mucous and muscular wall prevents the regurgitation of duodenal contents into the common duct and Coffey (1) as a result of experimental study has stated that this valve action is so perfect that the duodenum may burst from mechanical pressure before regurgitation takes place. This mechanism may of course be deranged by disease when near the papilla common duct stoma etc.

On the other hand taking for instance a disease like typhoid a true septicæmia where the bacteria are carried everywhere by the blood it becomes evident that they must be carried directly to the walls of the gall bladder and invade the mucous membrane from behind entering the bile by that route and forming nuclei for the numerous small stones which we find so often in acute cholecystitis following typhoid fever. The bacteria may of course pass to the bile through the liver cells and back up through the cystic duct from the gall bladder but even if this is the case the bacteria in the wall of the gall bladder must actually reach it through the blood stream for the resistance of the healthy mucous membrane to bacterial invasion is well known. Judd (2) has recently called attention to this point and has adduced the resistance of the urinary bladder to infection from pus flowing through it from the kidneys. The swelling of the wall then may obliterate the cystic duct or a stone may block it and acute cholecystitis result.

Of the greatest interest in this connection are Rosenow's (3) experiments in which he found that certain strains of bacteria find their best culture medium in certain organs to which for unknown reasons they are adapted. Bacteria cultivated from the tissue of diseased human gall bladders and from paraductal glands in chronic cholecystitis and injected into animals produce cholecystitis in more than two thirds of the animals injected.

Infection of the gall bladder wall may be acute or chronic, and the symptoms of the chronic form are the ill defined indigestions

and dyspepsias which are often associated with cholecystitis. If this is located in the gall bladder wall how is cholecystostomy going to cure it? Experience has proved that it does not.

Although we believe that infection is always precedent to stone it often happens that the infection may subside and the acute attacks for which we are consulted are due to the mechanical plugging of the cystic duct by stones or the moving of a stone through the ducts. In fact, in the early days practically all gall bladder attacks were attributed to stone and not to infection. Often on taking cultures from the bile in such cases at operation we find the bile sterile and although the gall bladder wall may be thickened from congestion the infection may have entirely subsided. The removal of the stones may here bring about a cure but the gall bladder probably more or less damaged will remain as a source of future infection and we are not sure whether infection is present or not. The enlargement of the gland at the junction of the cystic and hepatic ducts and of other glands along the common duct is evidence of cholecystitis and should lead us to do a cholecystectomy in cases in which there are no vital contra indications.

Denver (4) has called attention to oedema and swelling of the head of the pancreas and the glands about it in connection with cases of infected gall bladders and his observations have been confirmed by other operators.

The argument that the great advantage of long continued bile drainage was lost by cholecystectomy in these cases falls to the ground where the bile is sterile and also when we regard the infection as beginning in the gall bladder wall. The necessity of draining the infected bile from the liver our old bugaboo also falls to the ground according to our present views and the practical fact remains that a case in which cholecystectomy with ligation of the cystic duct is done has a better convalescence than does the case in which the gall bladder is drained from one to three weeks or until the fistula closes at least, this has been my experience. In cholecystectomy a conservative surgeon — and by *conservative* I mean one who conserves the lives

of his patients — will always carry a drain down to the ligature on the duct and if drainage is necessary in the given case the bile will find its way to the surface in two to six days and take care of itself. It is remarkable in how large a proportion of cases this gush of bile does not take place.

In jaundiced cases where the jaundice is due to the pressure of a stone or the swollen neck of the gall bladder upon the common duct, the jaundice clears up when the gall bladder is removed with the stone just as quickly as it does when the stone is removed and the gall bladder drained. Many times a small stone impacted in the cystic duct beyond the S curve cannot be safely removed without taking the gall bladder with it. In acute cholecystitis without stones we are dealing with a condition which may but probably will not, be cured by drainage. Here cholecystectomy is indicated.

In chronic cholecystitis without stones we have a thickened stiff walled gall bladder usually adherent to the pylorus omentum colon etc and forming stronger adhesions as time goes on. Its thick walls cannot contract and when they attempt to do so cause pain and indigestion which pain and indigestion are progressively increased by the development and strengthening of the adhesions. The tension regulating function of the normal gall bladder can in no wise be performed by such a crippled organ which is a nuisance instead of a help and should therefore be removed.

Acutely inflamed gall bladders especially gangrenous gall bladders should be removed if the operation is not too difficult and the patient's condition too poor. Gangrenous gall bladders if not taken out have to slough out, and the patient is subjected to long continued low grade infection while this is taking place. Recently in an acute perforation with bile in the general cavity, where a large gangrenous patch had given way near the base of the organ, I found it much easier to remove the gall bladder than to sew up the opening in the thickened friable gall bladder wall. In fact, the latter course was impossible. The gall bladder was removed and the patient made an excellent recovery. I may

remark in passing that perforations of the gall bladder liberating infected bile in quantities into the peritoneal cavity have been much rarer in my experience than perforations of the stomach and more serious too and prostrating. Of four cases of flooding of the peritoneum with bile two have died and those were the earliest operated upon.

In operating upon acute and gangrenous gall bladders we must never forget however the friability of the tissues about the cystic duct and that a roughly applied or sharp tooth clamp may cut through a soft walled artery and give us considerable trouble to catch it without invading the common duct. Important things are closely crowded in this region and a laborious suture of the common duct when you have cut or torn a large piece out of the side of it and its walls are more or less friable will assure any one that careful dissection sometimes repays the time it takes.

I have had the experience in a case where the gall bladder and ducts were much thickened of removing a single stone in the gall bladder and intending at first to drain better counsel prevailing have removed the gall bladder together with a good sized stone impacted in the cystic duct which without cholecystectomy might have been left behind with disastrous results.

We may here remark in parentheses that in a thickened common duct it may be impossible to feel a small soft stone and even with a history not conclusive of common duct involvement thickened common ducts should be opened and explored. When the common duct history (chills and intermittent and slight jaundice) is typical we are seldom disappointed in fact a ball valve common duct stone is one of the most open and shut propositions in diagnosis.

Opponents of cholecystectomy call attention to the fact that in removing the gall bladder we deprive ourselves of an important route for cholecystenterostomy in stricture of the common duct and in jaundice from pressure upon the common duct in pancreatitis. Now stricture of the common duct usually follows upon incision for the removal of stones in the duct or long continued irritation from the pressure of stones

which may have been removed or have been passed. In ordinary cases of gall stone disease without common duct involvement the removal of the gall bladder will prevent the recurrence of stones with their possible entrance into the common duct and causation of stricture etc. In these cases there can be no probability of the gall bladder being needed for cholecystenterostomy. I think however that in cases where the common duct is incised or there is much trauma and manipulation if the gall bladder is not too much thickened or contracted to be of use for anastomosis with the duodenum it should be saved. The operation for choledochoduodenostomy is as Guerry (5) has well pointed out so difficult as to be often impracticable. Unfortunately in most cases of common duct stone those of the longest standing and most likely to produce stricture the gall bladder is thickened and contracted down to a mere bud and can be of no use for cholecystenterostomy.

In regard to pancreatitis the case becomes complicated. In chronic pancreatitis with out jaundice consisting of simple enlargement and induration of the pancreas—that elusive entity which all surgeons find and of which many pathologists deny the existence—W. J. Mayo (6) states that when it is associated with gall stone disease the removal of the stones with drainage of the bile tract cures it if associated with cholecystitis without stones drainage gives temporary relief but cholecystectomy is necessary to cure. If this is the case as it seems to be it must be by reason of getting rid of chronic infection. I have adopted this method of procedure instead of simple drainage. In undoubted pancreatitis with jaundice from pressure of the swollen head of the pancreas on the common duct however (sometimes the duct runs behind the head so that no pressure takes place) it would seem that if we could save the gall bladder we ought to preserve it for a cholecystoduodenostomy or external drainage. In my own hands the former operation several times has been successful when the latter has failed.

In cancer of the pancreas with jaundice cholecystoduodenostomy has given surprising

temporary relief Judd (7) in a recent paper quoted above has called attention to experimental evidence that cholecystectomy causes dilatation of the common duct, which he believes results in paralysis of Oddi's sphincter and free drainage of bile through the papilla, so that the entrance of bile into the duct of Wirsung with the resulting pancreatitis cannot take place. We must await further evidence on this point, as the amount so far presented has not been conclusive although the accuracy of operation and clinical judgment of the author are of the highest. If this is the case, cholecystectomy is the best possible preventive treatment against pancreatitis. I believe that this will prove to be the case even if Judd's contention that dilatation of the common duct results from cholecystectomy is not borne out by the observations of others. If cholecystectomy will prevent the milder forms of pancreatitis alluded to above which are probably preliminary to the serious forms with jaundice it ought to prevent the latter also. Whether it would have a curative effect upon the cases already developed seems to me doubtful and I believe that here as stated elsewhere the gall bladder should be preserved for drainage.

One word about the cases in which the symptoms point to cholecystitis but at operation we find no stones but find the gall bladder normal in appearance and feel blue with thin wall and collapsible. What is to be done? First of course, carefully explore the abdomen for other possible causes of the symptoms with special attention to the pylorus, right kidney and appendix and then if no other cause be found what is there but to remove it?

Under the circumstances this is the only recourse open to us. In such a case as this removal is usually easy and pathological examination may result in the finding of round cell infiltration of the walls, papillomata of the mucous membrane or other evidences of cholecystitis. If a normal gall bladder is reported then we have made a mistake but we could not help it. Adhesions around the neck of the gall bladder and deformities may be cured by the removal of

adhesions and by drainage, but cholecystectomy is to be preferred.

When we speak glibly of the indications for cholecystectomy etc we must not forget that while in many cases the operation is extremely easy in others in which it is even more strongly indicated it may be technically so difficult as to be really dangerous for instance in fat old women with bronchitis or asthma or in deep chested men with the gall bladder deep down beneath a high lying liver. Here we must never forget that a patient relieved by incising and draining the bladder is better off than one insured against recurrence by removal of the organ. So we must in each case operate as conditions indicate.

Under what circumstances then should we remove the gall bladder? I have for years maintained that the gall bladder should be removed under the following conditions:

1 In cases of very thick acutely inflamed bright red or gangrenous gall bladders due to impaction of a stone in the cystic duct.

2 In cases of chronically thickened gall bladders. Here (a) the thick walls cannot contract and drive out the bile so that what bile gets back into the gall bladder is sure to stagnate there and (b) after cholecystectomy the walls do not contract, so that we get a mucous sinus for a long time or for life.

3 In cases of gall bladders very much distended with clear fluid from impaction of a stone in the cystic duct. Here the duct has been closed and probably ulcerated and strictured by the irritation of the stone so no bile gets back. In these cases removal is usually technically simple.

4 Whenever suspicion exists of malignant disease.

5 In chronic cholecystitis without stones, but with moderate thickening and ulceration of the mucous membrane giving little yellow spots on the mucous surfaces, the so called strawberry gall bladder. These do not get well with drainage alone.

6 In chronic cholecystitis without stones but with adhesions to the surrounding organs especially the pylorus which cripple the latter and cause symptoms. Here, also, drainage alone is only temporarily efficient. The gall bladder is a constant focus for low



grade infection and adhesions which will continue to form and perhaps spread until its removal all these processes being attended with discomfort and invalidism to the possessor of the organ

To these should perhaps be added in view of the definite cases of recurrence after operation that have occurred in my practice and also of cancer of the gall bladder and of the recent experience and quoted statistics of many of our best surgeons —

All cases of gall stones in which the operation is not for any reason unusually difficult or dangerous and

All cases of cholecystitis without stones where the same conditions exist

There can be no question that modern technique the use of adequate and properly located incisions the use of the gall bladder as a tractor to bring the liver practically out side the abdomen and keep it there while the common duct and cystic duct are tied and excising the bladder from below upward etc have done very much to render the operation simple and safe and for that reason as well as those given above the indications should be extended

In what conditions should cholecystostomy be performed

1 In all cases of acutely inflamed gall bladders with or without stones in which the patient's condition or the technical difficulties render the removal of the gall bladder unsafe

2 In cases of pancreatitis with jaundice Here cholecysto enterostomy should be performed if possible if not cholecystostomy

3 In cases in which the common duct is structured or is likely to become so and in which the gall bladder has not been already removed or is not too thickened and contracted to be of value for purposes of anas-

tomosis This presupposes a patent cystic duct

So far we have said nothing about the cases where gall stones are accidentally found when the abdomen is opened for other reasons notably for the removal of uterine fibroids Under these conditions if the operation for fibroids has been ordinarily simple and the patient's condition is good the gall bladder may well be removed If the procedure is unduly difficult the stones may be removed and the gall bladder drained I have almost invariably of recent years dealt with the gall bladder in pelvic cases where stones were found but in several cases where adherent pelvic tumors have necessitated very difficult and bloody operations and stones have at the same time been found in a gall bladder not badly diseased or thickened I have not disturbed the gall bladder reserving attention to this organ until such time as the patient has recovered from the operation and symptoms have developed which call attention to the diseased gall bladder I think we must admit that in certain cases this is the more conservative procedure

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## THE RELATIVE MERITS OF CHOLECYSTOSTOMY AND CHOLECYSTECTOMY<sup>1</sup>

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**B**ETTER diagnosis of the diseases of the gall bladder and ducts has reduced the operative mortality to a point so low that it can be further reduced only by parts of a per cent. The discussion as to whether cholecystectomy or cholecystostomy is the better procedure has been kept up from the earliest days of gall bladder surgery. We now find that there is no use for each in its place; cholecystectomy, however being chosen increasingly often as the operation of choice.

To aid in the selection of the method of procedure it is well to consider the function of the gall bladder, whether it is in any way necessary, or whether untoward results follow its removal. Is the mortality of cholecystectomy higher than that of cholecystostomy, and does the relief obtained by cholecystostomy average as high as that obtained by cholecystectomy? We must also consider the dangers of injury of the common and hepatic ducts incident to the removal of the gall bladder.

First as to the necessity of a gall bladder. The anomaly of its absence in man is a very rare condition. While several of the clean feeding animals, the horse, deer, rhinoceros, and a few others do not have gall bladders, the duct in these animals is larger than in those in which the organ is present. It is our experience that the ducts are increased in size after removal of the gall bladder, and the enlargement is usually present consequent to the disease at the time of the operation. That ordinary good health may be maintained for a number of years without a gall bladder is evident from the reports obtained recently regarding ten patients on whom cholecystectomies were performed in our clinic more than fifteen years ago. This does not take into account the large number of patients who have been operated on for shorter periods with every evidence of success. The average age of these ten patients at the

time of operation was 49.2 years; the oldest was 67 years and the youngest 37 years. The average duration of illness before operation was 6½ years. The longest history was 12 years and the shortest 7 months. Nine of the ten patients are living; one had good health for two years and died following an accident.

In what way is the bile changed by the gall bladder? It has been claimed that the addition of the mucus from the gall bladder renders the bile less irritating to the pancreas (Flemer), but the bile should not affect the pancreas unless there is some failure in the function of its delivery. It has been stated also that the bile drawn from the hepatic duct causes a more intense inflammation when injected into the pancreas than that drawn from the gall bladder. According to the commonly accepted theory of the function of the gall bladder, the organ is a reservoir capable of enlarging to a capacity of several ounces without consciousness of the change in size on the part of its possessor, and this elastic and muscular structure which contracts rhythmically from eight to ten times a minute pumps the bile into the intestine intermittently, overcoming the ring sphincter muscle of Archibald at the ampulla. On its way the bile does not re-enter the hepatic duct as the latter becomes closed from the mechanical pressure caused by the acute angle at which the cystic duct joins the common duct. Why should the gall bladder have a varying capacity? From its anatomical mechanical entrance into the intestine the duct passes through the muscularis of the intestine and then proceeds for a short distance between the mucous membrane and the outer wall; the orifice of the duct is beneath a large mucous fold. Food of a variety that tends to form gas and stasis of the intestine can produce no harmful effect on the duct, as the greater the pressure the more the duct entrance is closed by the mucous cuff and

the flattened tube in the wall of the bowel in fact the intestine will burst before permitting any reflux. In a varying degree the common duct at the ampulla is surrounded by a portion of the head of the pancreas. When this is the case pancreatitis tumors or malignant diseases of the pancreas may produce jaundice.

The ducts hepatic and common are muscle covered tubes and are functionally able to overcome Archibald's muscle and keep the bile moving into the intestine. Gall stones a solid evidence of disease are generally conceded to be the result of a previous cholecystitis of the mulder type as it is less common to find them in the severe cases of infection of the gall bladder. They are composed of the bile salts and cholesterol and from their centers bacteria can often be cultured. Since these stones are caused by an infection the question arises as to whether the infection is in the bile or in the gall bladder. As to the manner of its occurrence and its effect there has been much discussion. Does the infection pass through the lymphatics? Of this there is but slight evidence although the lymphatics are involved in cholecystitis. Do the bacteria pass backward from the intestine to the common and cystic ducts. The majority of observers believe that because of failure in the function of the liver which receives many bacteria through the portal circulation all of the bacteria at times are not destroyed. Therefore attenuated but living micro organisms gain entrance to the gall bladder through the bile and infect the wall by direct invasion of the mucous membrane. An elastic muscle walled sac lined with mucous membrane however is not any more vulnerable than the skin or mucous membrane in general. A great light has been thrown on the etiology of diseases of the gall bladder by the work of Rosenow, who shows that the attack is not frontal but from the unprotected rear that the bacteria are brought through the vascular stream to the capillary circulation of the wall of the gall bladder and that bacterial infections create stasis, infiltration, thickening of the mucous membrane and necrosis. He has shown that from acute and subacute in-

flammation of the gall bladder cultures of bacteria can be made only occasionally from the bile but regularly from the depths of the tissues. When injected into the blood stream of animals the bacteria will produce similar acute inflammations of the gall bladder in 80 per cent of them. In stagnation, cholesterol salts and bacterial cultures we have the origin of gall stones, the worst infections do not produce them. The essential feature of cholecystitis being infection we should find the lymph glands draining the gall bladder enlarged. This is a most important point in the diagnosis especially in those cases in which there is a little thickening but no adhesions. There are always three and there may be six glands on the common hepatic and cystic ducts. In duodenal ulcer and disease of the head of the pancreas these glands may be found enlarged. It is very necessary for the surgeon to accustom his tactile sense to their normal size as much depends on their evidence.

Cholesterol is an important constituent of gall stones which are large in bulk and light in weight. It is found to be increased in amount in the blood of adults with growing cells whether they are cancerous or embryonic. Its relationship to cell growth as the cause or effect is still under discussion but it is known that 75 per cent of gall stones occur in women and that in 80 per cent of these women the symptoms develop during the period of pregnancy. Thus have been explained certain symptoms which may be well called qualitative food dyspepsia which is due to certain kinds of food that develop gas such as raw apples and the oils of salads or fried foods that are tasted long and cause delay in digestion. The resulting stasis in the duodenum pinches the duct. A healthy gall bladder undergoes no stress or symptoms from gas because it is capable of expanding and caring for the ounce of bile delivered each hour for several hours and by its rhythmical contraction is able to pump it through the duct into the intestine against the internal pressure. If the gall bladder is diseased its capacity is reduced, its possessor is conscious of its expansion and its cramping is painful. In many persons the original cholecystitis

which caused the development of stones subsides. In such cases there is no associated qualitative food dyspepsia as the capacity of the gall bladder is not reduced and any symptoms are those of rare gall stone colic due to obstruction of the cystic duct. These persons may carry large and irregular stones for many years without symptoms. In such cases cholecystostomy (removal of the stones and drainage) would give a very high percentage of cure while the greater the evidence of infection, the thickening of the wall of the gall bladder necrosis and strawberry gall bladder the greater the indication for cholecystectomy as a general principle.

The fact is now recognized that at least one fourth of the diseased gall bladders do not contain gall stones but they cause severe colic from obstruction by balls of mucus and thick bile and more or less constantly run down the so called functional disorders of the stomach. In many of them the local areas of inflammation have produced a hyperplasia which shows as papillary growths projecting from the mucous membrane. In some of these cases it is probable that the process like other papillary growths of mucous membrane, is potentially productive of cancer and herein lies the fallacy of depending on the roentgen ray for the diagnosis of surgically diseased gall bladders. The roentgenogram cannot show papillary growths cholecystitis nor the severe infections known as strawberry gall bladder nor can it show early carcinoma. Therefore, to depend very largely on the evidence of the roentgen ray in the clinical diagnosis of gall stones would be to step backward many years its evidence should be merely corroborative.

In the experimental production of gastric ulcer in animals by means of cultures of bacteria obtained from gastric ulcers in man it is found that one of the marked secondary lesions produced is inflammation of the gall bladder. In the reproduction of inflammation of the gall bladder in animal experimentation carried from animal to animal there is a reduction in the percentage of cases of inflammation of the gall bladder but an increase in the number of cases of pancreatitis—the exact condition found in surgery

Pancreatitis probably occurs rarely without an accompanying inflammation of the gall bladder and when it does occur in persons whose common duct is obstructed by the pancreas is a symptom and there may also be pain in the back.

As to the surgical procedures which are indicated

Cholecystectomy would be indicated in the case of a cystic gall bladder with destroyed mucosa, empyema and functionless strawberry gall bladder. It would be indicated also in cholecystitis severe enough to give symptoms as cholecystostomy with its temporary drainage could not eradicate the bacterial inflammation of the wall of the gall bladder. Since as a result of the fixation of the fundus by adhesions incident to drainage the best working part of the gall bladder becomes inactive many patients with cholecystitis have great relief while the gall bladder is draining but the symptoms recur after the drainage ceases. When the gall bladder gives marked evidence of associated functional derangement of the stomach cholecystectomy should be performed whether or not stones are present. Cholecystostomy gives a high percentage of cure when the evidence of disease is slight stones are present, and gastric symptoms are absent. In associated pancreatitis drainage of the gall bladder for a considerable period rather than cholecystectomy would be indicated even at the expense of a second operation. Unless there are marked indications to the contrary cholecystostomy is advisable in pregnancy and for old people whose resistance is often surprisingly lower than their clinical examination indicates.

In discussing methods of performing cholecystectomy I would urge only that the cystic duct be early isolated and the common duct viewed before division of the cystic duct is effected. The cystic artery must be securely ligated as failure to accomplish this or slipping of the ligature has been the cause of numerous deaths this artery is as large as the artery of the thyroid. The cystic duct should not be ligated or divided too close to the common duct, as in many instances a permanent biliary fistula has developed as a

result of a too low division of the cystic duct with consequent injury to the common duct — one of the real danger of cholecystectomy.

Adhesions of the pylorus and duodenum to the liver or gall bladder often prevent the patient from receiving the full benefit of an operation even though the serious pathologic condition has been eliminated. If before closing the external incision fat does not already prevent the approximation of these structures an apron of fat should be developed by suturing the fatty round ligament or gastrohepatic omentum to the outer edge of the gastrocolic omentum drainage being placed between this fat and the liver.

In a paper read before the Southern Surgical Association in 1915, I reported results suggesting the relative merits of cholecystos-

tomy and cholecystectomy. Some hundreds of letters were sent to patients who had been operated on more than a year previously by cholecystostomy or cholecystectomy. Of those on whom cholecystostomies had been performed 53 per cent were cured and a large majority of the remainder improved. Of those who had had cholecystectomies 71 per cent were cured and a large percentage improved.

During the eleven months from November 1, 1915 to October 1, 1916 we performed 43 cholecystostomies with a mortality of 14 per cent, one half of the deaths being those of patients with cancer, 776 cholecystectomies with a mortality of 177 per cent and 102 choledochotomies with a mortality of 784 per cent.

## CHOLECYSTOSTOMY VERSUS CHOLECYSTECTOMY<sup>1</sup>

By JOHN B. DEEVER, M.D., D.Sc., LL.D., F.A.C.S., PHILADELPHIA

IF there is any question in abdominal surgery more difficult to decide with finality and on the basis of incontrovertible evidence than this same problem of cholecystostomy versus cholecystectomy I am not aware of it. Statistics are most fallacious at the present time since shifting opinions and changes in practice have made it impossible for anyone to collect series which are strictly comparable. Formerly the mortality of cholecystectomy in my hands was distinctly larger than that of cholecystostomy. During the past year this condition has reversed itself, the cases of simple drainage showing a larger percentage of deaths than when the gall bladder was removed. This does not prove anything concerning the relative dangers of the two operations but comes simply from the fact that formerly I removed gall bladders which showed extensive disease and drained those which were but slightly involved while latterly I have removed practically all gall bladders whether the seat of mild or severe lesions and have drained chiefly those that have presented

contraindications to removal in the shape of severe local lesions with general contraindications to extensive procedures. In the one case cholecystectomy had to carry the burden of the more dangerous cases and in the other the same group was saddled upon cholecystostomy with disastrous effects upon mortality statistics in each case.

One conclusion I have reached very definitely is this: that the mortality difference in the two types of operation is nothing compared to the mortality due to the local disease and general condition of the patient. In its larger aspects it seems like tweedle-dee and tweedle-dum to be discussing the relative merits of drainage and extirpation when the real bull's eye of the subject is the failure of the profession to recognize the surgical nature of gall bladder disease and the delay which ensues therefrom before surgical treatment is undertaken. If we could only eradicate the notion that gall stones are the essential indications for surgery in cholelithic disease it would be a great gain. If it were understood that the infection is the back bottom

and sides of this Pandora's box of upper abdominal troubles there would be less difficulty in pointing out that gall stones are but a single sequel and by no means the most important one of this condition. It is the metabolic disturbances, the lowered resistance, the organic degenerations consequent upon the infection that contribute by far the greater part of the surgical mortality. Upon these points let us present a united front to our medical brethren and let them not suppose that we are still uncertain as to the chief points at issue.

With the understanding therefore that in this gathering of surgeons we are discussing a surgical question which has in it only a minor part of the factors of mortality and cure, I will say that in spite of any figures to the contrary I believe that cholecystectomy in the average case will show an immediate mortality slightly in excess of cholecystostomy. It takes somewhat longer to execute, there is more trauma and there are certain operative dangers that are not present in the simple drainage operation and it is unreasonable to hold that in a given series some fatal outcomes will not be determined by these factors which would have been avoided by the simpler operation. If the case for cholecystectomy must rest upon proof of a primary mortality equal to or less than that of cholecystostomy, then in my judgment it will never justify itself.

But cholecystostomy will not cure all cases. We must remove the gall bladder which is the seat of hydrops or empyema or when the cystic duct is strictured or contains an impacted stone. The strawberry gall bladder must be excised if more than temporary relief is to be secured. We have long known that the prospect for permanent cure is not great if we leave behind a gall bladder which is greatly thickened or distorted and the only possible excuse for leaving a gangrenous or suppurating gall bladder is in case the dangers of immediate removal contraindicate this step. We have now come to the time when we can cast up our accounts and introduce the methods of efficiency which aim at the elimination of waste and the accomplishment of a maximum result.

A percentage of cases fail to obtain or maintain the expected result after operation upon the biliary tract. Since 1910 there were operated in the German Hospital 1189 cases of this type. Fifty one of these cases had had one or more previous operations upon the biliary passages so that 4.2 per cent of the work represented previous failure to cure. Sixty per cent of these cases had recurrences and were operated upon within one year after the first operation, 30 per cent were operated upon within the next three year period and 10 per cent were variously distributed from 4 to 17 years after the first operation. In one case carcinoma of the pancreas was found and in another the gall bladder which contained stones, had not been opened by the surgeon at the first operation. Leaving aside these cases as having no bearing upon the question we find that in 41 cases the primary operation had been cholecystostomy, and in 8 cholecystectomy.

In 65 per cent of the cases of recurrence after cholecystostomy the cause of recurrence was traceable directly to failure to remove the gall bladder. In 14 cases stones were present in the gall bladder or cystic duct. In 2 the cystic duct was strictured. In 6 infection had relighted in the gall bladder and in 4 pancreatitis was present. Adhesions were credited with the production of symptoms in 4 cases and may have been due to persistent infection. The remainder of the recurrences was due to stones which had been overlooked in the common or hepatic duct.

In the cases of recurrence after cholecystectomy the group due to persistent infection was conspicuously diminished and in fact comprised but one case of pancreatitis. In view of what we know of pancreatitis it is not fair to charge this condition to a failure of the primary operation as it may well have been due to another cause than biliary disease. In one case a duodenal fistula developed after the operation and the second operation was done for the cure of this condition. The remaining 6 cases were equally divided between stricture of the common duct (3 cases) and stone or stones in the common or hepatic ducts (3 cases).

This brief analysis shows that from the standpoint of the end results infective conditions of the biliary tract are best treated by removal of the gall bladder. This is in line with the much quoted recent work of Rosenow on the persistence of bacteria within the walls of the gall bladder and with the fact long known that catarrhal infections of the gall bladder are for practical purposes non-existent all infections being interstitial infections.

The recurrences which follow cholecystectomy are of a mechanical nature and are connected with thoroughness and care in operation. If such sequelæ occur the operation necessary for cure may be more difficult than when the gall bladder has been left *in situ*.

My feeling in regard to these two operations speaking generally may be stated thus: cholecystectomy is preferable in the hands of the master of biliary surgery since the mortality is but little higher in selected cases and the percentage of cures of the infection of the tract is greater. Cholecystostomy is slightly safer in many cases an eminently successful operation and the surgeon may always reflect that two operations on a living patient are better than one on a dead one. He should remember also that prolonged drainage is the secret of sterilization of the biliary tract and by this means may convert unsuccessful cholecystectomies into successful ones.

Cholecystectomy in the presence of jaundice and in the absence of a markedly and macroscopically diseased gall bladder is in my judgment out of place. Under these conditions cholecystostomy is the operation of choice.

Jaundice in the absence of inflammation and obstruction of the common duct is most probably due to cholangitis which calls for drainage. Drainage by way of the gall bladder is much more simply made than is drainage by the common duct. Further

the less the common duct is interfered with the better.

That we find more adhesions after cholecystectomy than cholecystostomy in cases reoperated upon is true. I have been so impressed with this that I do not fail to keep this in mind in deciding whether to remove the gall bladder in an otherwise borderline case.

The subsequent dilatation of the common duct and the stump of the cystic duct the latter not having been divided at its junction with the common to which attention has been called by different writers I have not met with in more than eighteen hundred operations on the bile passages. I have seen cystic formation in the neighborhood which was attributed to a collection of fluid in the drainage sinus which had not become completely obliterated. In the absence of obstruction to the normal outlet there seems to be no good reason to believe that back pressure upon the divided cystic duct is any more likely to cause dilatation than to dilate either the diseased or normal gall bladder under normal conditions. I am inclined to believe that this is one of those figments based upon a few observations improperly interpreted and passed along in the literature.

In the individual case I incline now to cholecystectomy when the gall bladder is obviously diseased and presumably the primary and residual seat of the biliary infection. This covers the vast majority of all cases. However when the infection is more distinctly cholangitic and intrahepatic as evidenced by minor appearances of inflammation of the gall bladder with thickening enlargement and a streaky appearance of the liver or secondly when the major lesion is in the pancreas or common duct I prefer to allow the gall bladder to remain using it for either internal drainage by cholecystoduodenostomy or for prolonged external drainage by cholecystostomy.

## FAMILIAL FIBROMYXOMATA OF THE PERIPHERAL NERVES

## A REPORT OF THREE CASES

BY L. A. FLEMING, M.D. AND J. W. MARVIN, M.D. BOSTON  
 From the Surgical Clinic of the Peter Bent Brigham Hospital

**T**UMORS of the peripheral nerves occur either as solitary or diffusely multiple lesions. Though they are not uncommon and have been the subject of much discussion in medical literature, chief attention has been paid to the one great division of the nerve tumors which are a feature of the disorder known as von Recklinghausen's disease. The cases which form the basis of this report illustrate a group of familial nerve tumors which do not resemble those occurring in generalized neurofibromatosis.

Though it is not our purpose to enter into a general discussion of tumors or tumor-like affections of nerves, a few words pertaining to their classification will not be amiss. They have been commonly designated as neuromata, even though the connective tissue origin of the larger number of them has been apparent. Indeed, some writers have doubted the existence of true nerve tissue tumors. In 1863, Virchow (1) in his celebrated *Geschnuete* classified tumors on a strictly anatomical basis and divided neuromata into the true and false. As it is the false neuromata with which this paper deals, it may suffice to say that after considerable controversy it has been very definitely established by modern staining methods that true neuromata, though rare, do occur but are confined to the sympathetic nervous system (2).

Interest has centered chiefly around the false neuromata, both solitary and multiple, due no doubt to their frequency and the extraordinary character of many of the cases. Many conditions affecting the peripheral nerves and skin were studied and described under various terms such as multiple neuromata, plexiform neuromata, molluscum fibrosum, and elephantiasis neuromatosa. They were regarded as separate lesions until von Recklinghausen (3) in his well-known monograph in 1881 demonstrated the histo-

logical unity underlying all of these morbid conditions and showed them to be but different manifestations of essentially the same pathological changes in the nerve constituents.

The main characteristics which serve to identify this remarkable disease as it is now recognized lie in the influence of heredity, the cutaneous pigmentation and the multiple skin tumors, the wide spread tumorous growths of the peripheral nerves and the frequent accompaniment of certain mental changes. So far as the peripheral nerves are concerned, however, the most distinguishing feature is that the affected nerve trunk and its branches are extensively involved, the term generalized neurofibromatosis being well chosen. For even though the nerve shows one or more tumorous masses as the conspicuous lesion, it nevertheless will be found that throughout its course it is in a state of fibromatosis.

There occurs, however, a group of cases with multiple nerve tumors which appear to be sharply differentiated from von Recklinghausen's disease. Among these tumors in Alexis Thompson's monograph (4) are included the painful subcutaneous tubercle, sarcomata, and all the circumscribed tumor formations to which the framework of the nerve can give origin. The point of distinction that is most emphasized between these and von Recklinghausen's disease is that they are circumscribed and occur in the course of an otherwise normal nerve. They are not encountered so frequently as the generalized form, and even though the tumors may be multiple, they are regarded as distinct from generalized neurofibromatosis.

As is true of the connective tissue elsewhere, the framework of nerves can give rise to both innocent and malignant tumors. Spontaneous malignancy, however, is rare and as a rule sarcomata of nerves are due to innocent tumors which have undergone malignant change. The usual varieties of con-





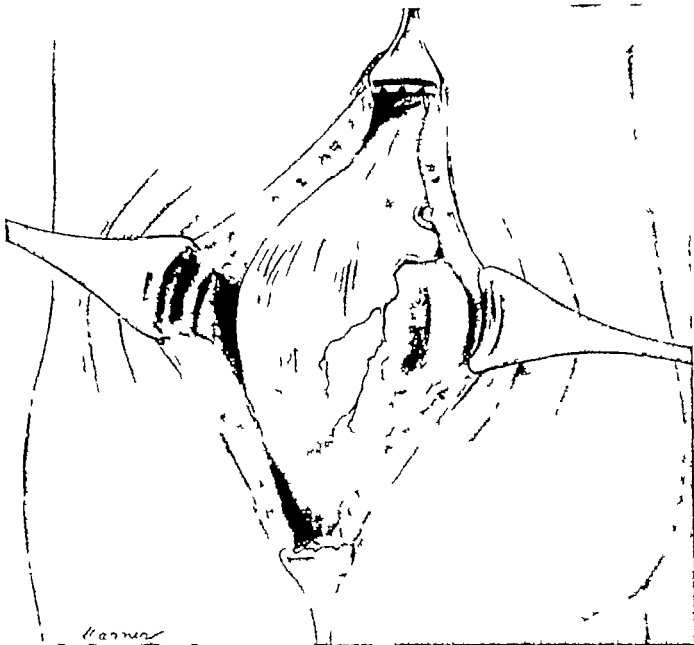


Fig. 3 Case 2 Operative sketch of the sciatic tumor (re-exposed)

She was able to walk but would pull the right foot and leg forward with a stiff dragging motion. In the midsacral region of the back was the scar of an old incision. There was no apparent difference in the size of the legs. The right leg was very sensitive to pressure and flexion was limited. Any movement of the foot caused severe pain. Over the right buttock and leg the skin was reddened and there were some enlarged veins (Fig. 2).

Cutaneous anesthesia involved the right foot and all corresponding roughly to the I and II sacral dermatomes. The reflexes on the right were sluggish and difficult to elicit. The tone of the sphincters was good. X-ray examination showed a slight curvature to the left of the lumbar spine. The Wassermann was negative.

In view of these findings we were at first in doubt as to the diagnosis though involvement of the cauda was considered possible in view of the fall she had received and the slight curvature of the spine.

A few days after her admission a brother (Case 2) entered the hospital unknown to his sister also complaining of severe pain in the leg and presenting a definite tumor at the fold of the left buttock and in his story he admitted that there was another brother who had had some tumors removed. The boy was blind and the presence of a sciatic tumor was

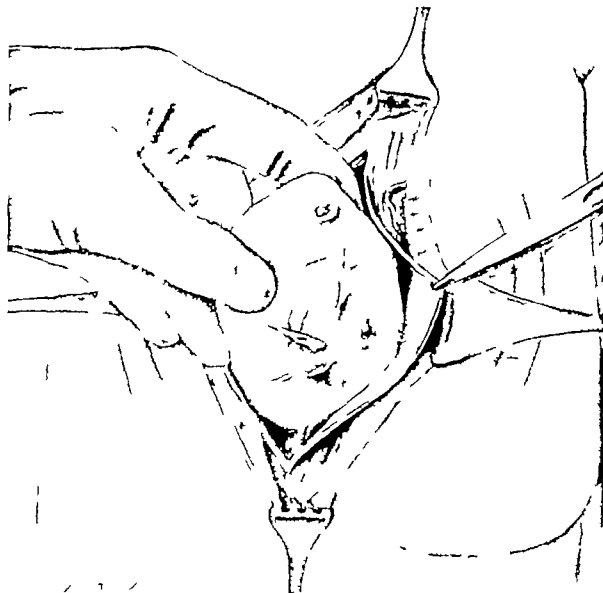


Fig. 4. Case. Sketch of incision on left buttock.

obvious. This led to a careful re-examination of the sister whose story will again be taken up in its chronological order. The brother's history follows:

CASE. Surg. N. 35. November 8, 1915. Admission of Bernard C. Young, H. Br. George, brother of Ann S. (Case 3) complaining of severe radiating pain in the left leg and swelling of the left buttock. His past history is without significant

trauma. In October, 1915, in descending some stairs he stepped upon the left heel of his

trunking his left leg. Some local tenderness persisted and after a month the left hip and back began to be painful. The discomfort increased in severity and soon he was unable to lie on the left side. In April the pain became radiating in character. He could not lie on the left leg when he jarred his foot. The pain has gradually increased and of late he has suffered from loss of sleep.

He first noticed a lump in the left buttock seven months ago but he thinks that it may have been there some time before he observed it and that it has not increased in size since.

One year ago following a slight blow he noticed a painful lump on the dorsum of the left fore

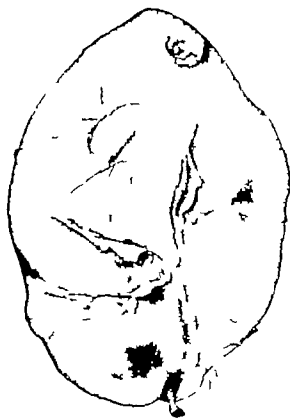


Fig. 5. Case 2. The sciatic tumor (natural size)

arm but is unable to say whether it was there before the blow or not. This lump is painful only on manipulation or when accidentally bruised.

**Physical examination.** A normally developed young man without blemish other than the conditions of which he complained. He was intelligent and without the hysterical tendency which had developed in the sister.

The left buttock was seen to be larger and of different contour than the right (Fig. 1). On palpation a deeply situated hard mass which appeared to be the size of an orange could be detected. It had a slight lateral mobility and was extremely sensitive. It was on a level with the great trochanter. The back of the left leg was extremely tender to touch throughout and it showed some relative atrophy. There were no areas of anesthesia.

On the dorsum of the ulnar side of the left fore arm was found a mass 5 centimeters long and 1.5 centimeters in width which was extremely tender to touch. It lay fairly deep under the superficial muscles. The left hypothenar eminence was no measurably smaller than the right.

There were no other growths found. The skin was clear and there was no evidence of a general neurofibromatosis.

All reflexes were equal and normal. The Wassermann was negative. X-ray studies showed no bony abnormalities.

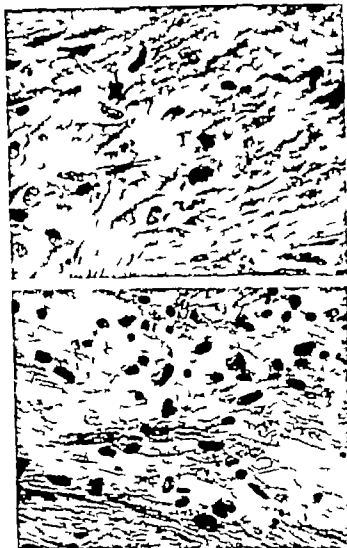


Fig. 6. Case 2. Histological appearance of the sciatic tumor. (above) Typical fibromyxomatous area. b area showing some increased cellularity with mitotic figures (cf Fig. 11).

The subgluteal swelling had been variously diagnosed before entrance as a tuberculous abscess, a sarcoma of the bone and a subgluteal bursitis, but the small tumor of the arm was at once recognized as a neuroma and it was presumed that the other swelling was of the same nature.

(CASE 2 cont.) November 12, 1915, operation. Under local anesthesia the small tumor of the arm was easily enucleated (Fig. 2). No nerve fibers connected with the growth were identified, but from its situation it presumably arose from the sheath of the posterior branch of the ulnar. On histological examination it proved to be a typical fibromyxoma.

November 13, 1915, operation. Dr. Cushing, Ithaca. A vertical incision was made from the crest of the ilium to below the gluteal fold and was





Fig. 2. Case 1. Tumor in process of enucleation showing point of adhesion to enveloping capsule where tumor was broken into during the procedure.

fibrils present everywhere throughout the living tumor. Diagnosis: fibromyxoma undergoing malignant change.

In view of this pathological diagnosis the outlook for this patient was poor. She improved greatly for a time but at the end of a few months pain returned and it became evident that there was an infiltrating mass deep in the gluteal muscles. This has been unaffected by radium and X-ray treatment.

Noteworthy features of this case were the difficulties in diagnosis which had misled those who had seen the patient early in the course of the growth at a time when a complete enucleation was possible and before the tumor had become malignant. The extreme pain which she suffered and the considerable loss of function in the nerve may have been



Fig. 6. Section at level of removal of tumor.



Fig. 7. Case After operation for comparison.

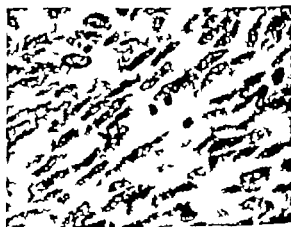


Fig. 8. Histological appearance of the section of tumor. Many small, dark, irregular masses, likely representing a tumor.

due either to this malignant change with involvement of nerve bundles or to pressure against the nerve within the sciatic notch, into which the growth extended. As a rule, regional anesthesia is not a common accompaniment of these tumors. It is significant that in Thompson's series of cases of malignant tumors of nerves one half of them were in the sciatic. The nerve was exposed for a considerable distance peripheral to its expansion over the tumor and it was of uniform calibre, smooth, and without evidence of the general involvement characterizing neurofibromatosis. There is little doubt but that the tumor removed from the patient's neck many years before was a fibromyxoma.

The third patient was only seen by us after his operations had been performed and we were unable to secure tissues for examination.

**CASE 3.** In 1913 C. B. came under the care of Dr. F. D. Donoghue of Boston to whom we are indebted for this record. He complained of tumors on his body and severe pain in the right foot. He was otherwise in good health. There were three tumors on the left arm corresponding to the course of the median nerve and two others were on the dorsum of the right thigh, the higher being at the gluteal fold. The duration of the growths was not recorded.

They were explored and excised and all were found to be enclosed within or attached to a nerve. The two in the sciatic nerve were both of the interstitial type, being enclosed in the nerve bundles.

Microscopically they were all fibromata or fibromyxomata and all were benign.

This patient presented himself for inspection in March 1916 and was found to be in good health with no evidence of recurrence. He had at this time a small palpable tumor in the inner side of the left upper arm. He showed no evidence of the von Recklinghausen's symptom complex.

The matter of chief interest in these three

cases of multiple peripheral nerve tumors lies in the fact that they have occurred in members of the same family. We do not find that such a familial tendency of the discrete false neuromata has been heretofore observed. It is true that the so-called plexiform neuromata are occasionally hereditary but these lesions are congenital as well and are closely allied to the disorder known as generalized neurofibromatosis but it is our impression that the cases under consideration do not belong in the von Recklinghausen group.

It would appear moreover that the tendency among the members of this family to these isolated tumors bears a definite relation to trauma. At least, in the first two cases the fact that a direct injury of unusual severity occurring in the same situation, was followed in each instance by a sciatic tumor would seem to be more than a coincidence.

In regard to treatment of these myxofibromata of the nerve sheaths early excision is curative. They rarely if ever recur if completely enucleated before they have undergone malignant change. When sarcomatous degeneration has taken place recurrence is the rule after an attempted enucleation.

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## INCONTINENCE OF URINE IN WOMEN

BY HOWARD CANNING TAYLOR M.D. AND CHARLES H. WATT M.D. N. Y. N. Y.

**DEFINITION** In this paper I wish to consider only cases of acquired incontinence of urine in woman due to interference with the continuity or the function of the vesical sphincter. Incontinence of urine due to vesicovaginal fistula or to disease of the central nervous system will not be considered at all.

The condition varies from a dribbling with any special exertion such as coughing laughing sneezing at which times a few drops or a considerable amount of urine escapes from the bladder to constant wetting with the retention of practically no urine in the bladder.

Incontinence must not be confused with an increased frequency or with urgent urination though these conditions are closely related and may all be associated in the same case.

In cases of frequent urination there is a frequent desire but there is no wetting if that desire is satisfied. With urgent urination there may be no increase in frequency but when the desire to urinate comes it can be resisted but a short time hardly time to arrange the clothing. Urgent urination may occur with a normal bladder which is abnormally distended it may be the result of mental influence it may be the result of irritability or inflammation of the bladder. With increased frequency and urgent urination there is always first a desire for urination while in incontinence the urine passes without any desire or inclination to urinate. It is well described as a leaky bladder.

**Frequency** The symptom incontinence of urine in some degree will be found frequently if patients are asked direct questions regarding it. Without direct questions women will speak of the leakage only if the incontinence is sufficiently marked to cause constant wetting. For some years past both in private and hospital work we have made a record of patient's control of the urine as part of our routine history. The degree of this control has been recorded as normal fair

poor or lost. A normal control needs no explanation. A fair control is one that is normal except at special occasions such for example as overdistention of the bladder temporary vesical irritability times of mental or physical fatigue etc. A poor control is one that allows the urine to escape on any special abdominal strain such as coughing laughing sneezing or with active exercise such as golf or tennis etc. Such patients are wet most of the time. When the control is lost the urine continually dribbles from the patient and practically no urine is retained in the bladder. Obviously this classification is arbitrary and inexact and one class merges with another.

FREQUENCY OF DISTURBANCE OF CONTROL

Chl. dist.	Good	Fair	Poor	Lost	Total
1-10	143	86	5	70	264
11-20	90	7	7	11	115
21-30	75	7	8	17	107
31-40	49	7	8	8	72
41-50	38	7	6	7	58
51-60	24	7	7	3	41
61-70	10	7	7	3	27
71-80	5	7	7	3	22
81-90	1	7	7	3	16
91-100	1	7	7	3	16
Total	143	86	5	70	264

The ordinary control of urine in women is not as strong as in men and only the two classes designated as poor and lost will be considered pathological.

To determine the frequency of disturbance of control of the urine in women we examined the records of 1006 cases in the gynecological service of the Roosevelt Hospital. The results of this examination are given in the table. It was found that the control was normal in 79.4 per cent fair in 6.8 per cent poor in 12.4 per cent and lost in 2.0 per cent. That is in about 15 per cent of patients admitted to a gynecological service in a general hospital the inefficient control of the urine was such that the leakage constituted a disagreeable symptom to the patient.

It was also found as shown in the table that the percentage of cases in which the control was poor or lost increased with the number of children which the patients had had that is the greater the number of children, the more frequent is the disturbance with the urinary control. The control of the urine was poor or lost in 8 per cent of the cases with no children in 14 per cent of those with one to three children 24 per cent of those with four to six children, and in 29 per cent of those with seven to nine children. It is interesting that none of thirteen cases each with more than ten children had any loss of urinary control. The number of these cases, however is so small that it can be ignored.

The nature of the pelvic lesion for which the patient applied for relief was found, as would be expected, to influence the percentage of cases of abnormal urinary control. Abnormal urinary control was found in 13 per cent of the inflammatory 20 per cent of the fibromyomata and 45 per cent of the prolapse cases.

*Causes.* Incontinence of urine may be the result of lesions—

- 1 Inside the sphincter vesicæ
- 2 In the sphincter vesicæ itself
- 3 Outside the sphincter vesicæ
- 1 Inside the sphincter vesicæ the lesion commonly causing incontinence is an increased irritability of the bladder. This may result from an extension of a pelvic inflammation to the bladder to a cystitis or trigonitis. The irritability resulting from concentrated urine may produce a temporary incontinence of urine in a woman whose urinary control is ordinarily fair.
- 2 In the sphincter itself the lesion may be
  - a An actual destruction of the sphincter muscle from injury or ulceration.
  - b An overstretching of the sphincter by instruments in examination or the removal of a stone.
  - c A weakening of the muscle as in advanced age and in prolonged serious illness.
  - d Interference with the nerve supply as in some cases of disease of the central nervous system.

The number of cases of incontinence of

urine due to a lesion of the sphincter vesicæ alone is small. Of the cases of abnormal urinary control in the series studies there was no case of lesion of the sphincter alone.

3 Outside the sphincter vesicæ incontinence of urine is caused by a displacement of the neck of the bladder and urethra usually associated with a prolapse of the anterior vaginal wall and base of the bladder. It is our idea based on a theoretical consideration that the prolapse of the neck of the bladder and posterior urethra does not involve the entire circumference of the urethra but only the lower part and that the incontinence is caused by the prolapse or dragging of the under part of the neck of the bladder which tends to hold the sphincter open and interferes with its proper action. Anatomically the neck of the bladder and urethra are attached above to the symphysis pubis by comparatively strong bands below they are closely incorporated with the anterior vaginal wall which is prone to become displaced. Theoretically therefore we would expect only the inferior part of the neck of the bladder to be prolapsed and would not expect incontinence if the entire neck of the bladder were prolapsed.

This explanation of the pathology of the incontinence of urine in this class of cases is supported by the treatment for its cure. An operation or pessary to remove this drag on the sphincter is usually necessary to cure the incontinence of urine. This class of cases includes the largest proportion of all cases.

#### TREATMENT

1 The treatment of incontinence of urine due to lesions inside the sphincter is to relieve the irritability of the bladder. The incontinence of urine in these cases is temporary and is easily corrected.

2 The lesions in the sphincter vesicæ itself which cause urinary incontinence and which require definite treatment are the partial destruction or overstretching of the muscle.

The treatment of incontinence of urine due to actual destruction of the sphincter muscle consists in exposing and reuniting the divided ends of the sphincter muscle. The operation is always difficult and the prognosis

# ETIOLOGY AND TREATMENT OF VARICOSE ULCER OF THE LEG

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ULCERS of the lower extremity are so distressingly numerous that no one can claim familiarity with more than a limited number of varieties. Yet in a tentative study of comparatively few disclose certain characteristics dependent upon anatomic and physiologic peculiarities of their environment and accounts doubtless for much that is obscure in their development and response to treatment. The ulcers here under discussion have been associated for the most part with varicose veins. A number of others resulting from trauma or sepsis but presenting certain common fundamental characteristics are included. All have been treated in the surgical clinic of the Peter Bent Brigham Hospital during the last four years.

## ETIOLOGY

*The causal relationship of varicose veins to ulcer.* In the case of the superficial veins of the legs the delicacy of the mechanism by which blood is passed toward the heart makes the establishment of surface varicosity a not uncommon occurrence. Overstretching of the vein wall and destruction of the valves upon which the mechanism principally depends bring about a degree of surface stasis which obviously interferes with the nutrition of the skin and subcutaneous tissues. Under these conditions the healing of injuries which is inefficient enough in otherwise normal dependent parts is particularly unsatisfactory. It is to be expected therefore that skin which is bathed under pressure in stagnant venous blood will readily form permanent open sores or ulcers. Moreover because of the arrangement of the principal surface veins of the leg these ulcers must almost of necessity occur in or near the middle half of the lower leg. The internal or great saphenous vein is a single channel in the thigh but in the calf it divides into a number of large branches each of which when varicose may be nearly as large as the parent trunk. The aggregate capacity of these branches must be considerably greater

than that of the main channel in the thigh and the flow of blood considerably slower. The middle and lower calf being the area of greatest stagnation is therefore most liable to ulcer while the foot is protected not so much by the habitual wearing of boots as by the free communication which here exists between the superficial and deep veins.

*The influence of trauma and infection.* Leg ulcers occur almost exclusively in those whose habits of life expose them to incessant work for long hours and whose surroundings and personal hygiene are necessarily not of the best. Varicose ulcer is in fact incident to hard work or lack of cleanliness or both primarily a poor man's disease though varicose veins are not perhaps much less common in the well protected than among the needy. It is evident that the former find time and means to protect their skin from abrasion and infection while the latter are unable to do so.

The onset and course of ulcer does not depend however primarily upon such factors but upon the character of the varicose veins and can be most conveniently discussed under two headings (1) *ulcers of surface varix* and (2) *ulcers of surface varix complicated by varicosity of the perforating veins including especially postphlebitic varix*.

*Ulcers of surface varix.* The most familiar type of varix is that confined to the surface veins. It arises usually from heavy straining lifting and long hours of work in the upright position and in women from childbearing. Its onset is no less gradual than its progression is certain. The surface veins are large prominent tortuous and in advanced cases sclerotized and calcified. In the presence of such veins the onset of ulcer is gradual. In many instances pigmented areas about the veins offer evidence of the prolonged irritation of the skin. These areas generally covering a distended portion of the vein ending as it is and may persist for long periods and even extend considerably without other

wise changing in character. Sooner or later however trauma or the actual rupture of the vein precipitates a painful inflamed ulcer. That such an ulcer soon heals upon elevation and rest demonstrates not only the restorative effect of improved circulatory conditions but the rapid subjugation of the skin bacteria. It is not at all common that an ulcer should remain healed for years only to become permanently established after repeated recurrences have lowered the vitality of the skin beyond repair. Once established and neglected it spreads to become finally a large discharging area of unhealthy granulations surrounded by a zone of inflammatory tissue. The skin about it is pigmented and the parent vein or veins can be seen entering the pigmented zone from above. In legs extensively scarred from long standing and repeated ulceration it is not uncommon to see the sudden recrudescence of widespread ulcers accompanied by evidence of cellulitis.

Such are the ulcers of surface varix. They are insidious in onset are confined for many years to the vicinity of the principal vein or veins of the calf and are said to ride them. Neglected they tend to spread increasing induration and scar tissue marking their advance until in the late stages large areas of the calf may be covered with vascular scars of low resistance.

*Ulcers of surface arrix (non inflammatory type) complicated by aricosity of the perforating eins.* When in the presence of varicose veins of the usual mechanical origin incompetence of the perforating veins develops the overflow or safety vent into the deep veins is taken away and nutritional disturbances tend to become more profound. One may expect therefore to find ulcers not only riding upon the large veins in the usual way but tending to appear in the region of the perforating veins. The accompanying photograph (Fig. 1) illustrates the earliest stage of such an ulcer. It is seldom indeed that in very advanced cases of varix there is not some incompetence of the perforating vessels. The ulcers found under these conditions differ in no essential particular from those of pure varix except that they may bear less local relation to the varicose surface vein.

*Ulcers of surface arrix (postphlebotic type) complicated by aricosity of the perforating eins.* The ulcers which follow phlebitis differ very decidedly from all others. The effect of the phlebitis following childbirth, fevers and intra abdominal operations is suddenly to destroy the valves of the vein (nearly always the internal saphenous and its tributaries) in which the inflammation occurs. The lumen is restored but the usefulness of the vein is lost. It remains usually a hard straight invisible but palpable cord through which back pressure from above is maintained as readily as in the case of the typical varicose vessel. If the inflammation has penetrated into its finer ramification the changes in the leg may be considerable — the fat extensively indurated and the deep fascia thickened and scarred. But whether because of the sudden strain upon them of caring for the surface circulation during the period that the main internal saphenous trunk is closed or because they themselves are directly involved the perforating veins very generally dilate and allow the blood of the deep veins to leak toward the surface increasing the confusion in the surface system. Moreover it seems quite likely that as a result of the inflammatory reaction the lymphatic circulation is at least locally crippled. I have even seen one instance of fairly well developed elephantiasis of the entire leg for which repeated attacks of phlebitis were clearly responsible. In other cases the tendency of considerable areas to become oedematous has appeared to be due to lymphatic rather than venous stasis.

The ulcers which occur often within a few weeks or months after the patient is on his feet are particularly malignant. They are often multiple they have no relation to any visible veins (no varicose veins are visible in any case) and little or no tendency to heal even upon rest in bed. There is evidently an interplay between infection and venous stasis somewhat different from that of the more common type of ulcer and there is evidence that infection may persist in the leg for months or years entirely apart from the ulcer as well as in its immediate vicinity for in extending the veins originally the seat of phlebitis one is disagreeably conscious of stirring up an

old infection and leaving areas of reddened oedematous skin for considerable distances about wounds which may have healed by first intention. Excision of ulcers of even a few months duration leads one through infiltrated oedematous tissue often to a depth of one to two centimeters and when the leathery base of the ulcer has been excised a high wall of inflamed tissue surrounds the spot. The wall soon melts under the influence of the removal of the infected area leaving a softer surface surrounding and almost on a level with the base of the excised ulcer. Finally the part played by the perforating veins is frequently demonstrated by the presence beneath the sole leather base of the ulcer of a huge dilated incompetent perforating vessel.

The essential characteristics of the ulcer of postphlebotic varix are the following. It always occurs (if at all) within two years and generally within six months of the phlebitis its origin is betrayed by the history and by the presence of hard small straight and generally invisible veins in the calf and thigh. It soon develops a firmly indurated base and is surrounded by a zone of thickened and irritated skin. There will often be found in other parts of the leg in which it is situated areas of oedema and induration as residual evidence of a very general infection of the subcutaneous tissues. It shows little or no tendency to heal under palliative treatment.

#### TREATMENT

Theoretically the excision of all varicose ulcers is ideal but practically is impossible and after the efficient removal of varicose veins a comparatively small number of cases are left which demand the radical treatment. One may perhaps outline the conditions which do not demand excision admitting that there are cases in which excision is optional with the operator and that there is always a border line group in which general considerations must influence treatment. Finally one may formulate the circumstances in which excision of ulcer is demanded for cure.

*Ulcers accompanying surface varix.* These are quite definitely the simplest type with which to deal and rarely demand excision.

They are generally small lie directly over a large vein or group of veins and heal readily when the stagnant column of blood above them is done away with. The veins should however be removed down to the ulcer and so thoroughly that there is no opportunity for the establishment of a new channel to it. The ulcer should be excised with the vein when it is high in the calf (inasmuch as the vein should be excised well down the calf and it is obviously inadvisable to transect an infected ulcer) and when it lies upon a narrow group of sclerosed adherent vessels whose removal is in any case demanded. If it is small and surrounded by healthy skin which promises to heal soundly excision is optional.

In long standing cases of the same type excision of ulcers is apparently desirable but owing to the huge area which must be so treated (practically the whole calf) skin grafting is particularly difficult. There is also a matter about which I confess to complete ignorance namely what will become of the lymphatic circulation after most of the tissue superficial to the muscle has been removed. I have seen a nearly complete ring of ulcer about the leg over two inches in width excised and grafted with excellent effect but feel that this may be a hazardous procedure. Therefore where a huge area of infiltrated tissue partly or wholly covered with ulcers is present I believe it is wisest to excise the varicose veins down to the ulcer area and at a subsequent operation to remove as much of the diseased skin as remains unhealed some months after the patient is again out and about. If the operator wishes he may try at the first operation to pick out a particularly diseased area and excise it. He may however accomplish little in this way and by giving the patient the impression that the operation though apparently unsuccessful has been sufficiently radical may prejudice him against a future procedure. It must be understood by the patient in these difficult cases that an operation must often be performed in more than one stage.

#### PROTOCOLS OF CASES ILLUSTRATIVE OF ULCERS ACCOMPANYING SURFACE VARIX

CASE 1 J J K No 292 male age 43 marine engineer Gradual enlargement of veins of



Fig. 1 B. S. N. 2053 Pre-ulcerous condition. Note pigmented area partly over vein in lower leg. At operation a varicose perforating vein was found under the center of the pigmented skin.

both legs for 8 years. Pigmentation of middle lower leg. Ulcers developed 3 years ago on right leg and 2 years ago on left as a result of trauma.

Wassermann negative. Trendelenburg test both legs—veins fill at once. Constriction test both legs—veins fill in 1 minute with additional impulse on release of constriction.

**Diagnosis:** Pure surface varix. Varicose ulcer (Fig. 2).

**Operations:** January 9, 20, 1913 (one leg at a sitting). Complete excision of varicose veins down to ulcer area. On right leg incisions above and below ulcer.

**Result:** Immediate excellent. Late 18 months excellent. Bruises healed well on shins. No discomfort. No reappearance of veins or ulcers (Fig. 3).

**Case 2:** J. J. D. No. 4320, male, age 62, lumberman sailor. Gradual enlargement of veins of both legs 40 years ago. Ulcers on and off for 35 years following crush of both legs. Long periods of healing. Has been skin grafted.

Wassermann negative. Trendelenburg test filling immediate. Constriction test filling in about 1 minute both legs, but extensive scars and in-

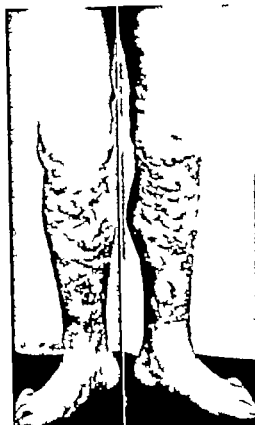


Fig. 2 Case 1 J. J. K. No. 229. Surface varix. Ulcers of several years standing in well developed pigmented areas tributary to immense varicose veins.

flammatory reaction make this test of doubtful value.

**Diagnosis:** Surface varix. Question of varicosity of perforating veins (Fig. 4).

**Operation:** March 11, 1916. Usual bilateral excision of veins down to ulcer area. Good healing. Scars almost invisible.

**Result:** Immediate see Fig. 5 photograph taken five weeks after leaving hospital. This is not to be considered final and the patient is to return for excision of such ulcers as may recur. He is considered to be still under treatment.

**Summary of the treatment of ulcers accompanying surface varix.** This is in the main the treatment of the varicose veins. Ulcers may be excised with the veins if failure to remove the ulcer means an incomplete removal of veins. In advanced cases the veins first should be removed. Large circumscribed ulcers upon a deep scar base may be excised with the veins and their bases grafted, but are better left until the effect of excision of the veins is known. In general the greater the possibility of efficient removal of veins and the less indurated the ulcer the less is the necessity for excision of the ulcer.

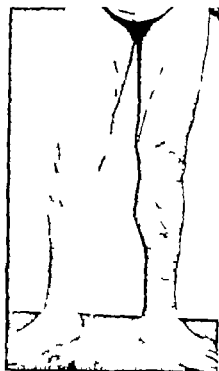


Fig. 4. C. J. J. D. N. 4320. Surface of leg after removal of the great saphenous vein.



Fig. 4. C. J. J. D. N. 4320. Surface of leg after removal of the great saphenous vein.

There have been 31 cases classified under this heading in the Brigham series. Including cases operated upon a little as 5 months ago 26 have been treated 23 are well 2 is unimproved 2 are still under treatment.

*Ulcers complicating surface area complicated by varicosities of the perforating veins.* The treatment of the muller portion of this group the cases of non-inflammatory origin does not differ in principle from that of advanced surface varix pure and simple. Inasmuch as wide areas of skin may be ulcerated careful excision of veins is primarily indicated and the question of excising ulcers must rest upon the results of the excision of veins. Operations may have to be performed at several sittings after the great saphenous vein

and its tributaries have been extirpated in the thigh and upper calf.

The treatment of the more interesting and important postphlebotic cases depends upon the recognition of the underlying condition. They have probably been classed as syphilitic by many unless Wassermann reactions have been carried out on account of the absence of visible veins the pain and tenderness in the leg and even the slight periostitis which may appear in an X-ray plate. The recognition of their real character is however most important for it has been demonstrated on several occasions in this series that removal of the varicose veins will not cause the ulcer to heal and in one instance that excision of the ulcer without removal of the veins is followed by recurrence. Moreover even if the veins and ulcer are both excised certain precautions must be taken in the convalescence or recurrence is probable.

The treatment which I have found most successful necessitates a rather prolonged stay

The above cases are all of the same type. The first case is a woman 45 years of age who has been suffering from a large ulcer on the inner side of the leg for several years. The ulcer is about 4 inches in diameter and is surrounded by a hard, indurated area of skin. The patient has been treated with various remedies but has not improved. The ulcer is now being treated by the method described in the text.



Fig. 5. Case 2 J. J. D. No. 4329. Three months after operation. Ulcers healed and scars in lower legs barely in. Patient is to return for excision of any recurring ulcer.



Fig. 6. Case 3 M. M. No. 3 and 1856. Postphlebotic varicose. Shows appearance of skin graft several years after the excision of veins and ulcer. The skin graft was in complete but remains in place. The new grown skin has broken down.

in the hospital. The patient is kept in bed until the maximum reduction of edema and inflammatory reaction about the ulcer has taken place. The ulcer is kept as clean as possible. It need not and never will be healed in the week or ten days which is required. The excision of veins is performed in the usual way but with every precaution against sepsis and trauma—oblique incision in the groin division of the great saphenous vein together with its high entering branches at the saphenous opening, stripping of the vein in the thigh and dissection by narrow full thickness flaps in the calf down to the upper limit of the ulcer area. The ulcer should be excised at this time and that with the most painstaking gentleness and thoroughness. The incision about the ulcer is drawn one centimeter from its border and is beveled toward its center so that the skin graft may be carried smoothly to the skin margin. When the cut has been carried to the level of the tissues on which the sole leather base of the ulcer rests whether this base be fat, muscle, sheath

or periosteum, one edge of the ulcer is turned up, seized with tenacula and the dissection carried under it from one direction. Particular attention must be paid to doing away with all scar tissue including the underlying sclerosed veins down to the deeper tissues. If as is often the case, a great incompetent perforating vein is found emerging from the muscle, it is ligated with fine catgut. The small perforating arteries are clamped with fine hemostats so as to traumatize only the smallest amount of tissue and are tied with catgut. Whenever possible bleeding is controlled by pressure only.

If these precautions are observed the base of the depression is composed of healthy tissue satisfactory for skin graft. Whether the graft shall be made at once is perhaps open to question. I have usually Thiersch grafted at once but when I have waited for granulations to form and grafted about ten days later I have been almost equally well satisfied. Provided the whole surface is covered with large fairly thick pieces of skin, the exact





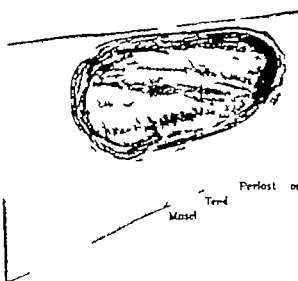


Fig. 9. Case 4 M N Nos 416 and 460. Shown area 1 ft after excision of ulcer. Note thickness of scar tissue below and leveling of edges. A varicose perforating vein has been tied in the center of the area. Muscle and tendon are 1 ft covered with a thin layer of tissue. From the scar of former operation is shown.

fulcrum have among others been selected. Other cases with illustrations have previously been published.<sup>1</sup>

CASE 3. M M No 3 No 1836 female age 40. Sixteen years before first entrance had milk leg (left) after pregnancy. An area like a blackish bruise appeared in lower left calf. A year later an ulcer developed there and has existed practically ever since.

At first entrance a tight band of indurated edematous scar tissue surrounded lower left leg. Very foul ulcer in its midst on inner side of calf. No visible enlarged veins on left leg. Right leg presents dilated tortuous varicose veins.

Trendelenburg test both legs—filling immediate. Constriction test right leg filling in 20 seconds left leg impossible to detect filling of hard veins.

Diagnosis. Right leg surface varix complicated by varicosity of perforating veins. Left leg same but of postphlebotic type. Varicose ulcer.

Operation February 1 and 8 1913 (one leg at each sitting). Complete excision of veins with sharp dissection of calves. Immediate healing.

Result. Right leg remains well. Left ulcer immediately recurred. Operation October 3 1914. Ulcer excised and partly skin grafted. Grafted area has remained healed. Area covered by new grown skin has again broken down (Fig. 6). Condition remains same at present.

This case illustrates the failure of excision of veins alone to cure such an ulcer. It



Fig. 10. Case 4 M N No 416 and 460. Same leg, four weeks after grafting. Note leveling of skin edge.

shows that skin grafted is likely to remain sound when skin grown by patient over an ulcer will break down. The patient could be cured by another graft but has refused. She is comfortable and is satisfied with her present condition.

CASE 4. M N (previously published in part) No 416 age 32 female. History of severe burn and probable double phlebitis as a child of 5. Was told that she had varicose veins at 15. Five years ago ulcer developed upon a furuncle of the lower left leg. Three years ago ulcer on right leg. At this time came to Brigham Hospital (Fig. 7). Examination showed typical postphlebotic varix involvement of perforating veins. Operation October 1 1913. Veins excised but not ulcers. Result immediate healing. Returned May 1916 with report that right leg had remained well but ulcer on left had recurred (Fig. 8).

Wassermann + + (no history obtainable). Operation May 1916. Ulcer excised (Fig. 9) and Thiersch grafted. Good immediate healing. Massage during gradual return to walking. Figure 10 represents condition four weeks after operation.





Fig. 13. Case 6 F A L No 4060. Typical ulcers of postphlebotic varix. Veins almost unnoticeable.

**Diagnosis.** Typical postphlebotic varix. Varicose ulcer.

**Operation.** January 11, 1916. Usual complete excision of veins down to ulcer area. Excision of ulcers 17 days later with Thiersch graft.

**Result.** Perfect graft on right. Secondary graft (partial) necessary on left. In hospital 3 months. Discharged in paste bandages. Figure 14 shows condition at discharge.

On June 17, 1916, grafts were in excellent condition. Some swelling of upper calf. (Patient was working long hours and drinking hard.)

**Summary of treatment of ulcers accompanying surface varix of postphlebotic type.** This is in the main the treatment of the ulcer. The great saphenous system must be extirpated, but great care must be taken against undue traumatism and a too vigorous dissection may be followed by prolonged swelling and even the formation of new ulcers. Ulcers must be removed in such a way that skin grafts may be completely substituted for the excised tissue. The treatment must be suited to the individual case but in general immediate skin grafts give the best results. Convalescence must be considered slow and



Fig. 14. Case 6 F A L No 4060. Five weeks after operation. Surrounding skin is now practically level with the graft. Some edema of upper calf.

care taken to promote the circulation of the leg while the patient is resuming his usual occupation. It is important that the patient should realize that a good result cannot be expected without the closest co-operation with the surgeon.

There have been 25 cases of ulcer accompanying surface varix complicated by varicosity of the perforating veins, both non-inflammatory and postphlebotic in origin. Twenty-one have been traced, 13 are well, 1 is improved, 3 are unimproved, 4 are still under treatment.<sup>2</sup>

The case reported as unproved has been described (Case 3).

These were considered as unproved (are ()) as an instance of post-phlebotic ulcer in a young man. The probable duration of treatment was held to be long but after one operation as a result of which the leg was really improved he refused further treatment. (1) A stout woman with double varix. Case was wrongly classified and ulcer was not removed. The patient was pronounced cured for further treatment. (2) An atypical case showing the appearance of post-phlebotic varix but with no history of phlebotomy. The ulcer was treated, the removal of the veins and the operation through it has never completely healed. The patient refused further treatment.

The cases at this treatment are: (1) recent, no phlebotomy, ulcer (both legs) (Case 6) the outcome of which is not asured; (2) an ulcer of 3 years standing, no phlebotomy, the ulcer was excised and not a tattoo; (3) a girl but were the patient has been treated by jelly bandages; (4) general condition of the leg is steadily improving; (5) post-phlebotic ulcer of both ankles (Case 4) which was removed, second operation but which may be considered cured; (6) Case 5 which has been held to be well.

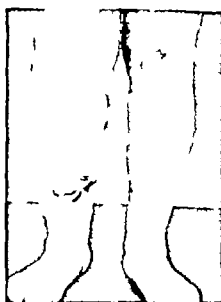
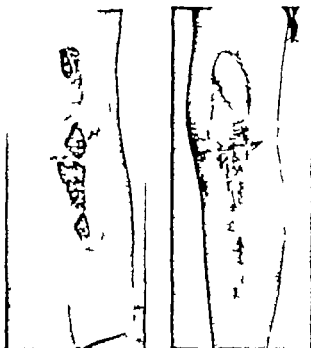


Fig. 1. Ulcer of medial malleolus. Fig. 2. Ulcer of lateral malleolus. Fig. 3. Ulcer of medial malleolus.

Fig. 1. Ulcer of medial malleolus. Fig. 2. Ulcer of lateral malleolus. Fig. 3. Ulcer of medial malleolus.

*Chronic leg ulcer of traumatic or infectious origin.* Of the five cases originally included in this series two should not perhaps be placed in this category. The first of these two was in an elderly woman suffering from diabetes. Her ulcer though situated in the usual position of varicose ulcer was thought as no veins were visible to be of diabetic origin. It was excised and grafted with apparent success but soon recurred and a more careful questioning showed that the patient had suffered from a milk leg some years before. Probably the ulcer arose principally as a result of phlebitis. The second of the two was a very heavy man of fifty whose leg had been crushed in an elevator the year before. The compound fracture healed in fair position but an ulcer remained. Examination disclosed small rather hard varicose veins of a postphlebotic type. Since removal of the veins the leg has healed leaving a very deforming scar. Neither of these cases can be said to be of traumatic or in-

fectious origin yet neither would generally be considered a varicose ulcer. The first might perhaps have been cured had excision of the veins been more promptly recommended. The cure of the second cannot necessarily be attributed to excision of the veins. Each illustrated a mixed type which should be kept in mind.

Of the other three cases two were straightforward cases of obstinate ulcer of large extent following in one instance compound fracture fifteen years before and in the other an infected hematoma of the popliteal space. In each the Wassermann reaction was negative. Excision of the ulcer including a very thick leathery vascular base proved curative and immediate Thiersch grafts were satisfactory in every way. It was noticeable however that the graft in the case of popliteal ulcer (Figs. 15 and 16) showed a tendency to slough while the patient lay on his back but improved immediately when he was kept for the most part on his face. Both cases illustrate as in varicose ulcer that healing which has failed to follow the palliative treatment occurs when the heavy scar tissue base of the ulcer is removed and in this connection I should like to enter a protest

against the so called scarification of such ulcers for this it seems to me can only result in the end in making more fibrous the base of the ulcer

The fifth and last case was one of ulcer of both legs. Sixteen years before entrance of the patient following childbirth suffered from swelling of both lower legs especially the right. Local areas of pigmentation developed later and seven years ago an ulcer appeared inside the right calf. A year ago a similar ulcer appeared on the left (Fig. 17). The patient was so excessively fat that no veins could be seen or felt but from the history it was judged that a postpartum phlebitis had occurred. Exploration of the right leg failed to show however any abnormality of the surface veins except in the immediate vicinity of the ulcer itself. Here the veins were thick walled and almost obliterated but the most striking abnormality was the very general scarification of the subcutaneous fat and deep fascia of the calf. The ulcer was so small the area of pigmentation and induration so large and the inflammatory reaction in the calf so general that any idea of excising the ulcer was abandoned and the lowest incision packed with gauze. Subsequently the granulating surface was skin grafted.

Some months later the left leg (the one not disturbed) was healed and well but the right presented a number of new ulcers similar to the first. In fact the right leg had apparently been made worse by operation. This result might I believe have been foreseen and indicated that as in cases of typical great saphenous phlebitis dissection of once inflamed veins in the calf must be most cautiously performed. In other words if the area altered by the previous inflammation cannot be excised it should be treated in a palliative

way by rest by massage and by bandaging. The difficulty may quite possibly lie with the lymphatics and the condition may be one of elephantiasis.

In summing up the treatment of chronic leg ulcers not obviously of varicose origin it may be said that when well defined of any considerable size and presenting a hard scar base they are best treated by radical excision and skin graft. When they are a manifestation of a general previous infection of the subcutaneous tissues (and local veins) of the lower leg they should be conservatively treated by measures tending to improve the surface circulation.

#### CONCLUSIONS

1. Varicose ulcers take origin in profound nutritional disturbances attributable to varicose veins but their incidence and development are profoundly influenced by trauma and infection.

2. Varicose ulcers arising from the familiar type of surface varix run a chronic course and are generally healed by adequate removal of varicose veins.

3. Varicose ulcers dependent upon post phlebotic varix are characteristically different from the first class in appearance rapid in development, always intractable to palliative treatment, generally incurable by the removal of varicose veins alone and must be excised to be cured.

4. The lower leg once the seat of phlebitis must be most carefully dissected and every means should be employed to improve during a protracted convalescence the circulatory conditions in the leg.

5. Chronic ulcers originating in trauma and infection should if well defined be excised and grafted.





Fig. 1. Roentgenogram of pelvis (in situ) showing fetus at eighth month. Note that the head bones very distinctly as well as many other of the fetal osseous structures. Normal case.

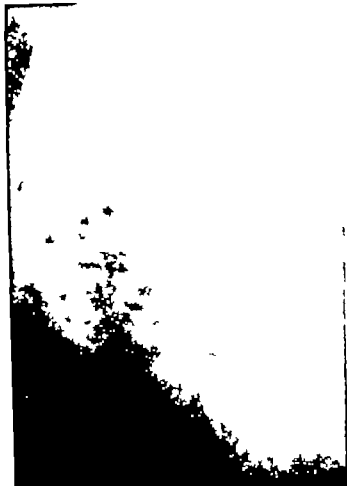


Fig. 2. Roentgenogram of anencephalic fetus (intra-uterine in situ). Note the absence of the cranium and unusual appearance of the bones of the face and base of the skull.

injury to the fetus. This erroneous notion is also held by many laymen.

The monstrosity which will be most easily discovered is the anencephalic because the fetal head shows earliest and plainest. This monstrosity ought therefore to be discovered in every case. The rounded shape of the head is conspicuously absent even in plates which show distinctly the spinal bones, the bones of the base of the skull and of the face.

Sometimes help may be afforded in settling the question of possible death of the fetus if carefully made plates show distinct shadows indicating that during a certain interval no growth has occurred. Failure on the part of the mother to feel fetal movements is one of the signs of fetal death but does not positively indicate it.

In the following case I successfully diagnosed anencephaly before birth the diagnosis being based upon the roentgen appearances. I believe this a unique case for a careful search of the literature has failed to disclose

the report of a similar instance. I am quite sure that many forms of teratocephalus, teratomelus and double monsters can likewise be roentgenologically distinguished and possibly also some forms of hemiterata and spina bifida.

Mrs. X, para III. The first two children were normal in every respect. Nothing unusual occurred in connection with the delivery in either instance. The early months of the present pregnancy had passed without any untoward event. Fetal movements were felt at the usual time but the attending physician was unable to make out the fetal heart sound. The placental sounds were loud and the amniotic fluid seemed excessive. It was thought that these two factors might have prevented the detection of the fetal heart sounds. Another month passed yet in spite of prolonged and repeated efforts to hear the fetal sounds none could be made out.

At about the seventh month the patient was referred to me for obstetrical examination. The







Fig. 3. Photograph of the macerated anencephalic fetus after delivery.

birth the mere fact of pregnancy has been established in a number of cases by means of the roentgen method. Last year Dr. Monash referred to me at St. Luke's Hospital a case for differential diagnosis between pregnancy and pelvic tumor. The serological test which was considered perfectly reliable having been made in the laboratory by a physician whose work stands high in this field was quite negative although the roentgen examination indicated pregnancy of about four and one-half months. The question of differential diagnosis arose from the fact that no fetal movements could be felt. The patient was allowed to go on with her condition until toxemia began to manifest itself. Then Dr. Monash induced labor and delivered a macerated fetus of about five and three-quarters months.

The following are a few notes bearing on the subject of roentgen diagnosis of pregnancy which I have culled from the literature.

Imbert (1) reports a controversy between Dr. Iedenat and other physicians in regard to the differential diagnosis between pregnancy

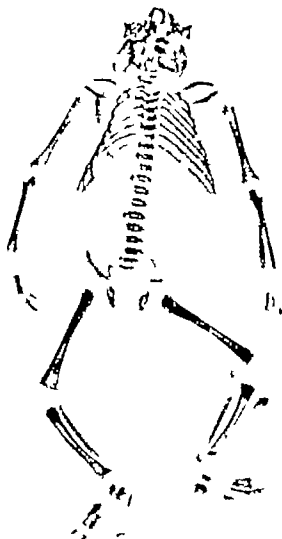


Fig. 4. Roentgenogram of the anencephalic fetus after delivery.

and tumor. Dr. Iedenat's roentgen diagnosis of pregnancy proved correct.

Albert (2) as far back as 1899 showed a number of roentgenograms at a meeting of the German Society of Gynecologists in which the fetal heads and some of the bones could be clearly seen.

Muellerheim (3) likewise in 1899 showed a series of roentgenograms taken after death. They all showed pregnancy which was confirmed at autopsy. Later he reported 22 cases in which pregnancy was roentgenologically diagnosed during life.

Von Jaksch (4) states that he has repeatedly succeeded in visualizing the gravid uterus from the second month. He used metal filters and rather hard tubes the time of



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## ADVANCED EXTRA-UTERINE PREGNANCY WITH LIVING CHILD, PRIMARY LAPAROTOMY<sup>1</sup>

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THIS condition presents the most serious possibilities for operative treatment found in the pregnant woman. It is with rupture of the uterus and complete placenta previa forms a triad where the urgency of hemorrhage may demand prompt and skillful attack to prevent death primarily from hemorrhage or secondarily from shock or sepsis.

The number of reported cases is small. Harris (1) in 1887 first reported a series of cases of primary laparotomy. Ten years later he reported a series of additional cases (2). A summary of these 77 cases is tabu-

lated in Kelley's *Operative Gynecology*. Ayres (3) in 1897 added 14 cases to this list. Sittner (4) in 1900 from these and additional cases summarizes 121 authentic cases from 1813 to 1900. In 1903 he added to this list 15 additional reports and in 1908 completes his summary to 1906 with the addition of 43 cases (5). Horsley (6) in 1913 reports 10 new cases.

Primary laparotomy, the term used by Harris includes those operations upon advanced extra uterine pregnancy where the fetus is living.

Secondary laparotomy in advanced extra

protuberant and ovoid in shape and fetal parts are plainly palpable on the left side at the level of the iliac crest. Fetal movements are visible and palpable the fetal heart tones are in the upper left quadrant and their rate is 140. The bladder seems distended. The genitalia introitus admits two fingers the cervix is soft and lacerated and the external os admits one finger. External pelvic measurements: intercostal 25.5 centimeters inter spinous 33 centimeters Baudelouque 18 centimeters. Urine examination the following day shows neutral reaction amber color and specific gravity of 1.010 and no albumin or sugar present. Blood exams also: hemoglobin 60 per cent white blood corpuscles 5400 red blood corpuscles 435000. Differential count polymorphonuclear 30 large mononuclear eosinophiles 1 basophiles 1 no myelocytes or transitional cells.

A few hours after entrance the pains in the abdomen ceased. She was seen on the third day thereafter by the members of the attending staff because of a resumption of the abdominal pains together with the eccentricity of the fetal parts and the unusual location of the fetal heart tones. Examination of the abdomen at this time showed flatness over the left half and resonance on the right. The small parts were superficial and had sharp protuberances especially noticeable at the height of the left anterior superior iliac spine. Palpable resistance continued upward to the costal margin. In the median line there was resistance at the height of the umbilicus that was suggestive of a distended bladder or a uterus twenty-four weeks pregnant. Vaginal examination showed a soft cervix with a uterine mass above somewhat harder but fetal parts could not be felt or could the uterine mass be definitely outlined manually.

From this examination it was deemed possible that either there was an ovarian cyst of the right side displacing a normally pregnant uterus upward and to the left a bicornuate uterus with the left horn impregnated or an extra uterine pregnancy. Palpation of the fetal parts was quite unsatisfactory because only a small part of the fetus could be outlined. This was high and apparently with the breech down.

Examination by roentgen ray clearly revealed the cause of this and also of the persistent nausea and vomiting for the breech was at the level of the iliac crest with the back anterior and the fetal head was quite under the costal arch and in the region of the stomach. Therefore the head was entirely beyond reach by palpation. The accompanying photographs show the position of the child schematically as derived from the roentgen negatives themselves for they were too thin unfortunately to reproduce satisfactory prints. The negatives also showed a shadow corresponding to the mid line resistance and above this the left arm of the fetus extended across to the right side of the mother below the liver. The diagnosis of extra uterine pregnancy was rendered definite by

the position of this arm extended at right angle to the fetal axis.

During the following week the patient complained of abdominal pains irregular in occurrence but of increasing frequency. The occurrence of these caused only an increased abdominal resistance and no changes were perceptible in the vagina. Because of their increasing frequency a primary laparotomy was decided upon at this time.

On October 12 1915 under ether anesthesia and with tincture of iodine preparation of the abdominal field the abdominal cavity was opened by a mid line incision. The fetus was lying in a thin sac anterior to the intestines and omentum and in the position shown by the X-ray. The sac was incised the living child delivered and the cord tied and cut. The baby was 18 inches long and weighed four and a half pounds. Following this an exploration was undertaken to determine the blood supply of the cyst. A mass the size of a grapefruit presumably the placenta was felt at the pelvis thus was adherent to the broad ligament uterus and sigmoid. As this examination was in progress sudden massive hemorrhage began so a hasty removal of the placenta was done and control of the hemorrhage was attempted by tamponade. A large amount of packing was left *in situ* and the abdominal wall closed with catgut and silk worm sutures. The patient showed considerable shock at this time and returned from the operating room with a pulse of 13 and respiration 44. On October 13 the patient had a temperature of 100 F pulse rate varying from 124 to 32 of poor volume and tension and the respiration varied from 24 to 32. Considerable serosanguinous discharge came from the wound. On the 14th the same general condition was present with also marked restlessness. This was controlled by hypodermic injection of morphine. This also was necessary the following day. On October 16th the packing was removed and a gauze drain inserted.

There was a profuse discharge of a serosanguinous character at this time. The temperature was 99.6 F the pulse varied from 120 to 138 and the respiration was 24. On the following days the condition remained the same. The patient evidently was not gaining. A restless day with rising respiration on the 22nd of October was followed by a secondary hemorrhage the morning of the 23rd with death about 9:00 a.m. The female baby though resuscitated with difficulty apparently was doing well when it suddenly died half an hour after delivery.

No autopsy examination was permitted by the husband.

The great question in advanced extra uterine pregnancy with a viable fetus is: What procedure safeguards to the greatest extent the interests of both mother and child? This naturally remains debatable.

in view of the small number of cases reported many of them before the days of modern technique

The treatment of extra uterine pregnancy diagnosed in the early stages is now definite. The axiom of Pinard Every diagnosed early extra uterine pregnancy should be operated on without delay—receives universal acceptance in such cases with only the dissent of the patient as a possible opposing factor. However at times it happens that early diagnosis is not made either because the patient in the absence of abnormal symptoms has had no examination or because with obscure and not urgent symptoms the fetus has arrived at viability before a positive decision has been possible or necessary.

From reported cases we must conclude that the operative treatment of extra uterine pregnancy before viability of the fetus is not always possible even though the patients are under competent observation.

Boquel's case (11) in which both mother and child were saved by late operation illustrates the very real difficulty that the diagnosis of extra uterine pregnancy may present in the early weeks. His patient was seen repeatedly during such a period. Early vague pelvic pain on the right side caused an attempt to differentiate extra uterine pregnancy from possible renal colic or appendicitis. Though later the latter conditions could be eliminated he then was unable to decide that angular pregnancy was not entirely responsible for all the symptoms and conditions found. There was an entire absence of two independent tumors in the pelvis a diagnostic finding usually present. Later the operative findings explained this variation fully by the location of the placenta. The pain present was such as previously had enabled him several times to correct the erroneous diagnosis of extra uterine pregnancy where retroflexion of the gravid uterus was alone concerned. There was nothing characteristic. He found only pain that was variable and even absent at times. He emphasizes the fact that the patient at no time either during pregnancy or when in apparent labor expelled any uterine casts, nor did even slight bleeding occur also that

the abdominal tumor showed no irregularity. This differs from the common belief. The periods of pain were frequent at the beginning of pregnancy less toward the end. During the last two or three months on the whole the patient lived as *tout le monde* though she was more tired than normally and walked with difficulty. The final diagnosis was made solely from the not striking fetal poles. The operative findings in this case postulate an early tubal abortion, but a positive diagnosis was not possible even when carefully kept under consideration.

Werder (7) suggests unusual sensitiveness on abdominal examination as an important factor to differentiate extra from intra uterine pregnancy. In several cases where ectopic pregnancy was suspected because of the apparent superficiality of the fetus he also was greatly puzzled and only corrected the diagnosis to intra uterine pregnancy by palpating the intact amniotic sac through the internal os. These were cases of an atypical relaxation of the part of the uterus containing the fetus while the other half remained hard and firm. The coincidence of an intra uterine abortion followed by curettement, with an undiagnosed extra uterine pregnancy in Werder's second case (7) shows what care must be constantly exercised. Dubose's case with such a coincident intra and extra uterine pregnancy reaching term and with the mother and both twins saved shows the possibilities of such conditions attaining perfect end results.

Grimsdale (15) reports a case operated upon with a diagnosis of a solid ovarian tumor which proved to be an old ovarian pregnancy with fetal remains and it is of interest here because the history gave no evidence of abdominal pain suggestive of a ruptured tubal pregnancy or hemorrhage or of spurious labor at any time. In fact, the history of three intra uterine pregnancies the last one within two months previously suggests an unrecognized ovarian pregnancy coincident with one of the earlier uterine ones.

Himmelsbach (16) in 1914 reports a case where, after repeated examinations for four weeks an extra uterine pregnancy with a dead child of five months development was

operated upon abdominally. The diagnosis of extra uterine pregnancy was made only after exploration of the uterus which was four and a half inches deep and empty. There was no history of hemorrhage nor was a ruptured tube or ruptured uterus present. The sac was attached to the omentum and to no other organ.

Mercer (17) quotes a case seen ten years before of a five months pregnant woman who later came in at term because of a peculiar pain in the abdomen. No uterine movement was observed but tense abdominal muscles were felt and also a foetal kick one side and the extremities could be made out. After 24 hours of this spurious labor without progress a diagnosis of abdominal pregnancy was suggested by him. Two other physicians disagreeing operation was refused. The woman died twenty four hours later still in labor. Here again there was no history of hemorrhage or pain in the early months. Postmortem examination showed that the large placenta reached almost to the kidney and that the tubes were entirely intact.

Of atypical cases that are obscure for diagnosis one of the most interesting is reported by Minassian (18). It was apparently a true abdominal pregnancy because there were present normal signs of pregnancy: amenorrhoea, nausea and vomiting and normal breast changes. There was a total absence of the symptoms of tubal abortion such as uterine hemorrhage, cramps or faintness. Foetal movements were felt from the seventeenth to the thirty second week after which time the foetal heart tones were no longer heard. Ectopic pregnancy was only suspected at term when the uterus was examined and found empty and only slightly enlarged. Celiotomy showed the gestation sac to be without parietal adhesions and without connections with the pelvic organs but it was connected with large omental vessels and there was intimate envelopment of the transverse colon. Both tubes and broad ligaments were intact and both ovaries were present. There was no evidence of salpingitis or constrictions of the tubes and the uterus was only slightly enlarged and normally anteverted. The foetus was of

seven months development and slightly macerated and it was necessary to resect eight inches of the bowel to remove the placental mass. The intimate involvement of which diminished the lumen of the colon and even caused a sharp constriction at one place.

Hoffman (19) reports a full term foetus in a 40 year old primipara whose pregnancy was without complaints and where the patient was brought to the hospital after twenty four hours labor because of lack of progress. The child was apparently dead. Even then only after dilatation of the cervix and exploration was the uterus found empty.

The abdominal pregnancy so diagnosed was removed by laparotomy. The death of the foetus apparently was due to the spurious labor.

Though secondary laparotomies at times are done from choice often they result from earlier failures to diagnose the character of the pregnancy with death of the foetus occurring with or without spurious labor some time before the operative interference.

Dr G. W. Green (20) in this city last year successfully removed a gestation sac containing a dead foetus weighing  $8\frac{1}{4}$  pounds and normal in appearance from a broad ligament and retroperitoneal site. He first saw the patient seven weeks after a forty eight hour false labor which marked the cessation of foetal heart tones and movements. At that time the abnormal situation was unrecognized. Here too an operative exploration of the uterus determined the true condition. This is an example of secondary laparotomy not from deliberate choice.

After viability of the foetus the new factor of the child's welfare is added for consideration. Two groups among physicians therefore are formed. *First* those who presumably consider only the mother's welfare in advising either immediate intervention if term is yet some weeks off or else the deferring of intervention until the death of the foetus has been certain for several weeks. This group is apparently lessening in numbers. *Secondly* a group increasing in numbers

who hold that the welfare of the child is also a factor of merit.

Sittner (5) concludes that the life expectancy of extra uterine children though not particularly good still warrants trying everything to save their lives. In his combined reports 122 foetuses were beyond 32 weeks development 59 of these died within one month a mortality of 48+ per cent 51 therefore were spared the injurious effect of the abnormal site of the egg. Malformations and developmental defects are not rare but to so great a degree that later life of the surviving infant is questionable is not at all common.

Deviations of form facial deformities depressions of the skull facial ptylises anomalies in the position of extremities and hip joint dislocations have been recorded but the surviving infants rarely die because of any malformation.

Of the 63 infants alive at the age of 1 month the later fate of 12 is unknown 14 died within the first year 8 died within the second year 6 withdrew from observation at varying intervals up to 15 years 11 were alive at time of report in 1900 the oldest being 19½ years of age. To this his last report adds 12 cases the youngest 1 and the oldest 7 years of age.

The advocates for the child advise in the premature cases that intervention be delayed to near term to secure further growth of the foetus while in the cases near term intervention should if possible precede foetal death. They believe that the inherent operative dangers do not markedly differ between the sixth and tenth month of pregnancy while the extra uterine foetus especially adds markedly to its chances of surviving by additional growth and so needs as great development as possible before operative delivery. Though delay may expose the mother to some danger this is especially at term or with spurious labor. The danger of secondary rupture of the ac in the last half of pregnancy is slight. Sittner (4) reports only 7.4 per cent in 579 cases which included 179 viable foetuses.

The reappearance of abdominal pain in our case induced intervention to save the child.

Occasionally maternal and frequently foetal death is accompanied by so called false or spurious labor. False labor pains have been defined as colicky abdominal pruns accompanied by uterine contractions. What then is this so called spurious labor and what are its clinical manifestations? Boquel (11) gives a careful description of this process. In his case it was not really identical with normal labor it rather was only analogous. The onset was definite and from two to three weeks before term according to the amenorrhœa as reported by the patient and this coincided with the length and size of the child. The pains were very short in duration and irregular in occurrence. Two or three recurred at intervals of two or three minutes followed by a very considerable space of five minutes and ten minutes. Once three quarters of an hour of complete relaxation occurred during which the patient complained only of feeling marked sensations caused by the foetal movements. Boquel could not satisfy himself whether these pruns as alleged really coincided with uterine contractions. Abdominal palpation revealed only tenseness of the abdominal wall and bimanual examination only tenseness of all the mass. No modification whatever was felt in the completely softened cervix. No changes of the genital canal indicated labor but breast changes were noted in that milk or a modified colostrum appeared. Boquel concluded that the foetus was being rapidly endangered by this false labor because four and a half hours after its beginning the amniotic fluid was already strongly tinged with meconium and the amniotic liquor had transuded through the sac at least to the level of the anterior abdominal wall.

The dangers in primary laparotomy to which the mother is exposed result from hemorrhage shock and sepsis. Hemorrhage primarily is immediate and follows mistakes in attempted removal of the placenta and sac also in such a case shock may be increased by the urgent combating of hemorrhage while the lowered vitality caused by these two factors may give added opportunity for infection to become established.



Sepsis may be a prominent factor when the removal of the sac and placenta is not attempted at the time of the primary operation especially when adequate drainage is not employed. Elytrotomy is not to be thought of when the extra uterine foetus is alive and secondary laparotomy is only advised on the ground that it diminishes the dangers from hemorrhage though this delay may and often does increase the dangers from sepsis. Dunning (21) draws from a comparison of 40 cases operated on in 1894, 1895 and 1896 that the percentage of maternal recoveries is greater when the foetus is alive than later after fatal death. Therefore the operation of choice is between secondary laparotomy and the variety of primary laparotomy free from hemorrhage is the latter for it does not inevitably forfeit the infant's life and even the dangers from sepsis may be less.

The best mode of treating the unremoved sac and placenta is by what Pozzi termed marsupialization by which we mean the sewing of the edges of the gestation sac to those of the abdominal incision after the removal of the foetus and of the cord close to its implantation. This closes off the large intra-ovular pouch from the general peritoneal cavity and by gauze packing and drainage of this pouch the effort is made to control infection during the following 20 to 50 days in which the placenta and sac are being cast off.

The ideal result to be outlined by primary laparotomy however is by total extirpation of the placenta and sac when it is possible. Sittner terms this indirect removal in that the gestation sac containing the placenta is entirely removed with also such organs as have served as extensive surfaces of adhesions while by direct removal he means the peeling out of the placenta alone or with only a part of the membranes adherent to neighboring organs.

In direct removal therefore besides the immediate danger of hemorrhage and shock already alluded to a less immediate though marked factor may be that resulting from the wounding of the various organs such as intestines, ureter, spleen, liver etc. with which the sac and placenta may have formed

adhesions thus adding to the shock and affording new avenues for infection.

In advanced extra uterine pregnancy with living foetus our final choice of attack must be primary laparotomy either with marsupialization or with the extirpation of the placenta by direct or indirect removal.

Ilauchus (12) concludes that total ablation of the sac is more surgical more brilliant more quickly curative but operative hemorrhage can be controlled with difficulty and may cause some very serious immediate dangers. This invites our attention to the question of the origin of the hemorrhage.

We may consider it as definitely established that massive bleeding comes from torn placental blood vessels and not from the removal of the membranes though doubtless in drawing out the sac manipulations in trying to remove it entirely may cause capillary oozings. A massive hemorrhage arising perhaps after a reasonable removal of the sac comes not from the adjacent organs but from the tearing of vessels arising elsewhere that run through the membranes.

The problem is therefore what is the origin of the placental blood supply? Potocki acted on the enunciated principles of O'Neill in two cases with encouraging success. He believed that placental vessels of an abdominal pregnancy primarily tubal come from the uterine or ovarian vessels. He therefore did such a preventive hemostasis by ligating these vessels and so obtained complete control of free bleeding from a partially detached placenta.

Boquel does not think broad ligament ligaturing adequate. He believes that it is necessary to consider also vessels not originally objectively apparent. By completely loosening the placenta and then bringing it up gently it is made easy to see and ligate all vessels running from the placental periphery because they are by this means isolated from the mass to which they return. An otherwise formidable danger is thus controllable and really this is only a particular instance of the mode of attack used upon hemorrhagic tumor in general. He agrees completely with Potocki in the belief that the

placenta and membranes are not really inserted upon the abdominal organs but are simply adherent to them in which case there is no possibility of large vessels emanating from such organs with the sole exception of the omentum (As to the latter we all must acknowledge the possible omental origin of placental vessels) He found notwithstanding an extended placental insertion on the uterus sigmoid and descending colon that after the placenta and membranes were freed the hemorrhage was stopped by ligature of the vessels at the placental periphery. The organs appeared denuded and reddened but there was no oozing. He concludes therefore that hemorrhage from torn adhesions can only be important when these are so strong that they cause lesions of the organs themselves and that it cannot be really from placental vessels arising therefrom. Therefore a grave hemorrhage from the region of an organ, when laceration of the organ is not present necessitates only search for an overlooked placental vessel coursing through the sac wall. Savage's case is interesting here in that massive hemorrhage after placental removal necessitated control by tamponade but large placental masses subsequently discharged through the sinus. This strongly suggests the presence of an overlooked placental lobe as the causative factor. Boquel handled such a situation by finding the placental remnant and ligating its vessels. This second class of laceration dangers is encountered most often in total enucleation of the gestation cyst where this should not have been attempted because direct removal would afford a safer attack in that portions of the sac are left where dense adhesions are present, and thereby organ laceration is prevented. Werder's (7) second case resulted fatally but he attributes the lethal result to the failure to do a preventive hemostasis by ligating ovarian and uterine vessels because of the obstructive placental situation. As an aid to the control of such situations he suggests instrumental compression of the abdominal aorta by the Hiltz method.

In his third case after ligation of the

pedicle of the right adnexa and broad ligament, he found the placenta 15 centimeters in diameter in the lowest part of the sac quite intact and perfectly dry, although the whole sac was attached to the right side of the uterus and extensive omental and intestinal adhesions were present over its whole upper aspect.

We agree in Boquel's recommendation for immediate intervention if the foetus is alive and near term (primary laparotomy) without awaiting the onset of false labor and if the foetus is dead without the usual classical wait of 4 to 6 weeks thereafter (secondary laparotomy) believing that such delay does not give compensation for the increased disability and incident risk of sepsis.

Werder with three cases uncompromisingly advocates the removal of placenta and sac as the only proper and true procedure.

Cragin with three cases advocates marsupialization in the majority of instances.

Therefore as to the technique of the operation to be followed let us consider Sittner's summaries of mortality percentages.

Period	Number of Cases	Mortality percentage
1813 to 1886	34	83.3
1887 to 1890	20	40
1891 to 1895	36	27.7
1896 to 1902	41	17

The first improvement was due of course largely to the adoption of modern surgical technique in its broadest aspect. Since that time the continued decrease in mortality rates has been almost entirely due to the increased proportion of cases in which fortunately placental removal was the procedure used. From 1891 to 1895 placental removal was employed in 60 per cent of cases; from 1896 to 1900 placental removal was employed in 65 per cent of cases; from 1901 to 1906 placental removal was employed in 70 per cent of cases.

Today removal of the placenta with a mortality of 15 per cent, is three times safer than marsupialization with its mortality of 45 per cent, due to septic infection, fistula, hemorrhage and general exhaustion. That

this conclusion is inevitable a study of the following rates will show

For the 20 year period 1887 to 1906—  
 Marsupialization showed a mortality of 30.7 per cent direct removal 6.8 per cent indirect removal 8.5 per cent

In the last ten years of this period—  
 Marsupialization showed a mortality of 25 per cent direct removal 10.5 per cent indirect removal 5.2 per cent

While in the last quarter 1901 to 1906—  
 Marsupialization showed a mortality of 40 per cent direct removal 12.5 per cent indirect removal none

Sittner's general conclusions are that leaving the placenta behind according to any method gives no good results for even marsupialization gives a discouraging mortality of 40 per cent in the 1901 to 1906 period

Upon what basis shall direct or indirect removal be chosen? This must be dependent upon the anatomic relations of the gestation sac and the placenta. These markedly affect the course and prognosis of the particular case. For instance an intestinal insertion of the placenta yields poorer results because with it direct removal is usually necessitated though Minassian (18) avoided this by a resection of the bowel with success.

In Sittner's last series of 43 cases the placenta and sac were left in 11 cases. In the 32 cases in which the placenta was removed the foetus in 4 cases emerged into the broad ligament between its leaves, in 26 cases emerged completely and in one partly into the abdominal cavity in 12 of these with a newly formed secondary sac and in 14 of these in the abdominal cavity and of these latter 7 were without an amniotic sac.

The placental insertion in 31 cases was within the gestation sac in 4 in 12 the insertion was only upon the pelvic organs and abdominal wall in 11 the insertion was upon both pelvic organs and intestines and in 4 upon the intestines only.

The reason of the low mortality of in direct removal becomes apparent if we remember that the cases so treated are usually those that present little operative difficulty.

Werder's last case and Dubose's reported earlier in the paper illustrate this strikingly.

Werder says it was easy beyond expectation. Dubose says the blood lost did not exceed 4 ounces. Horsley's case also a complete extirpation presented likewise very little difficulty.

We may therefore outline the general technique of operation to be followed

1 Incision either median or external rectus through the abdominal wall but as much as possible outside of the placenta should thus present.

2 Open the sac in the least vascular area available and remove the baby with careful avoidance of traction on either cord or sac.

3 Make a careful exploration of cyst connections.

4 If these are pedunculate in character ligate the pedicle and enucleate the whole cyst *en masse* if this can be done without violence.

5 If these are not pedunculate and especially with a history of tubal abortion

a Do a preventive hæmostasis by ligating the uterine and ovarian vessels also all omental connecting vessels that are visible using great care not to pull upon or tear the sac.

b If the placental location prevents ligation of the uterine and ovarian vessels secure preliminary control by either digital or instrumental compression of the abdominal aorta with subsequent ligation of these vessels.

c Then without hesitation or delay separate the entire placenta rapidly and completely and with it bring the membranes up gently in order to ligate any vessels running through them to the placental mass even in their transparency.

d Avoid strictly the use of undue force either with the fingers or with instruments throughout the separation and extraction of membranes.

e If marked oozing follows tampon with a Mikulicz drain otherwise leave a cigarette drain for 48 hours as a safeguard. Do not close the abdomen without some drainage.

6 Consider marsupialization only where rapidly is indicated because of urgent need.

for the completion of the operation or where because of exceptional location the removal of the placenta would either endanger the integrity of adjacent organs by denudation or laceration or prevent proper hæmostasis thereafter

## SUMMARY

1 Advanced extra uterine pregnancies will continue to present problems of operative treatment

2 Spurious labor marks a danger to foetal life

3 When the foetus is viable interference should be as near term as possible Primary laparotomy should be the operation of choice

4 When the foetus is dead laparotomy should be done without delay

5 In all conditions of the foetus—

Total extirpation of the cyst where feasible gives the lowest maternal mortality

Enucleation of the placenta alone where feasible gives the next best prognosis but it demands adequate preliminary hæmostasis

Marsupialization should be the last choice because of its higher mortality

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CHRONIC HÆMOGENIC SALPINGITIS<sup>1</sup>

By W C DANFORTH BS MD FACS EVANSTON ILLINOIS  
Surgeon to Evanston Hospital

AS medical literature gives but little upon the relationship of infection of the fallopian tubes and chronic focal infections I venture to present this case

Young woman age 30 trained nurse referred by Dr W G Alexander History as follows In 1905 was operated upon for acute gangrenous appendicitis no drainage Subsequent to this operation persistent pain in the right side and obstinate constipation the obstinacy of which increased Tenderness in right side In 1906 was again operated upon At this time constricting bands were found with adhesions of bowel to bowel and bowel to omentum These were released and following the operation there was practically complete relief from pain for three years In 1908 she entered training as a nurse with her general health much improved and having gained 16 pounds in weight In 1909 pain reappeared in the left side and was accompanied by obstinate constipation Some nausea and loss of weight Olive oil enemata

daily for a month did not relieve the constipation In January 1910 she was operated upon again for the relief of more adhesions More constricting bands were found at this time This gave complete relief for several months followed by recurrence of pain on the left side The constipation again appeared more pronounced even than before and was accompanied by loss of weight At this time she had a nervous breakdown In 1913 she was operated upon and at this time there was found a large firm constricting band binding down the sigmoid and causing almost complete obstruction Ovaries and tubes were stated at this time to be normal Pain recurred shortly after this operation increasing gradually and accompanied by frequent attacks of nausea Loss of weight

In 1914 she came to me for another attempt to relieve her In February 1914 the abdomen was opened by a long median incision Rather extensive adhesions were found and divided involving the lower coils of the ileum and a band constricting the sigmoid similar to that described

by previous operators. After attending to the adhesions a careful search was made over the entire abdomen. On inspecting the pelvic cavity both tubes were found to be studded with small whitish nodules the tubes themselves being rather larger than normal and distinctly injected. Both tubes were excised. No other demonstrable lesions were found.

The tubes were sent to Dr. E. C. Rosenow for pathologic and bacteriologic investigation. He reported that the cultures made from the lumen of the tubes gave a pure growth of streptococcus hemolyticus. He prepared a vaccine. The sections made from the tubes gave the usual findings of a chronic salpingitis.

After the recovery of the patient from the last laparotomy she was given a dose of the vaccine prepared from the cultures grown from the tubes. She had immediately a severe pelvic pain. It was necessary to reduce the dose of vaccine to an extremely small amount in order to avoid severe reaction. In going into the history of this case with her physician it was found that about a year before the last laparotomy that is the one done by myself she had had an attack of acute tonsillitis at which time a culture showed a pure growth of streptococcus. The tonsil remained large and there were persistently palpable glands in the neck. Frequently during the six months following my operation she had a slight fever. The tonsils were accordingly excised by Dr. C. J. Swan in November, 1914. She was then sent to the country for six months and gained 26 pounds. On her return she had again some slight temperature and discomfort in the neck and an X-ray showed an alveolar abscess under a molar tooth. This was extracted by Dr. H. A. Potts who made a culture from the abscess cavity which gave a pure growth of streptococcus. This culture was examined by Dr. Clavis Henry Dick and gave the usual reactions for streptococcus.

We have in this case a complete chain of bacteriologic evidence running from the teeth through the tonsils to the abdominal cavity. The original focus from which the entire process was derived may logically be supposed to have been in the alveolar abscess and the tonsillar infection a secondary one. The tubal infection can only have been a hemogenic one and must have come from the foci in the tonsils or teeth. Any neisserian infection could be entirely excluded on the history which in this case was clear cut and absolutely dependable. The failure to relieve her permanently at any of the earlier operations was undoubtedly due to the failure to find or recognize the tubal lesion and to follow that lead to its ultimate conclusion.

It is not contended that this case represents

a really rare pathology. It is true that reports of similar cases are scarcely to be found in the literature but the absence of such report is undoubtedly due not to the fact that such cases are infrequent but because they are not recognized and the relationship between focal infections and chronic tubal processes has not been understood. As this patient's earlier operations had been done by men of unquestioned standing in Chicago the failure to find the seat of the trouble was not due to mere carelessness or ignorance. *Accumulating evidence will undoubtedly show us that many tubal infections which we have considered to be of external origin are in reality blood borne.*

The fact that an open anatomical path exists between the genital canal and the outside world has made us too skeptical of the possibility of hemogenic infection. That hemogenic infections are possible is proved by the case quoted by Davis as having been observed in the clinic of Dr. J. C. Webster. A young woman in whom an anatomical malformation existed so that the cervix was not connected with the vagina and was connected with the uterus only by a fibrous band completely excluding any possibility of infection from without had a salpingitis from which was recovered a pure culture of streptococcus.

Acute cases of salpingitis secondary to tonsillar infections are much more frequently reported. There have been four cases of acute general suppurative peritonitis following streptococcus infection of the throat seen in the Evanston Hospital. One of these in which an acute ovaritis was followed by an acute suppurative peritonitis is the subject of a recent report by Wilder. Systematic observation and study of our cases will I believe convince us that chronic hemogenic salpingitis is very much more common than we have supposed.

A careful search of the literature has revealed but little. There are no cases in which the connection between focal infections and the resulting tubal pathology has been clearly shown. Fromme states in *Vent's Handbuch* that many cases of tubal infection are caused by the migrating of bacteria

by way of the blood stream or the lymphatics from distant focal infections but that the relationship will always be difficult to prove definitely. Definite proof rests only upon careful pathologic and bacteriologic work in which surgeon and laboratory worker must co operate and at present may fairly be said to be established.

As far back as 1884 Leyden reports a case of death from peritonitis involving the tubes ovaries and surface of the uterus following an attack of tonsillitis. Dieulafoy reported a similar case in 1901. Pfannenstiel writing in Vent's *Handbuch* states that he believes that ovarian infections are often conveyed from distant foci and speaks of a case reported by Poter but without mentioning the original focus.

Fructus in 1913 in an article on salpingitis in virgins, discusses infections by other pathways than the genital canal and says that infection may be transmitted by way of the blood stream or by contiguity as from an infected appendix. The relationship between these haemogenic forms of salpingitis and any form of infective focus is not entered into.

The haemogenic origin of acute appendiceal infection is of course commonly known. I had during the last epidemic of tonsillitis a few months ago within a very few days sent in for operation three cases of acute appendicitis all of which were just recovering from throat infection.

While the extreme frequency of tubal infection by way of the genital canal cannot be questioned we must I think admit that haemogenic infections are decidedly more common than we have been accustomed to suppose. The literature of the future will undoubtedly show many more such cases than have appeared in the past. It behooves all of us in cases in which the genital origin of infection is not quite clear to search for a possible other cause of tubal infection. Careful study of these cases will I am sure emphasize to us the already recognized fact that haemogenic chronic salpingitis is fairly common.

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## ABDOMINAL MYOMECTOMY AND HYSTEROMYOMECTOMY BY MORCELLATION<sup>1</sup>

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IN the surgical treatment of the fibroid uterus the multiplicity of the tumors and the large size of the tumor mass often add very materially to the difficulty of removal. The larger the tumor the larger the incision is the time honored dictum. That these operations may be greatly facilitated by decreasing the bulk of the tumor mass as the removal proceeds and that this

method of removal means greater safety to the patient are the two points I shall endeavor to bring out in this paper.

Ordinarily these tumors are removed en masse through a large median line incision—the size of the incision being proportionate to the size of the growth. The intestines are then packed out of the way with laparotomy pads the uterus delivered and myomec-

tomy or hysteromyomectomy performed as the case may be. This method of procedure has the following objections:

1. A large median line incision gives a high percentage of postoperative hernia both primary and secondary and there is great exposure of the abdominal viscera during the operation.

2. Laparotomy pricks traumatize the intestines adding to the danger of ilius and postoperative infection. Exposure and traumatism of the viscera are of very grave importance and in every abdominal operation should be reduced to the lowest possible minimum. Laparotomy pricks always a menace to the patient are unnecessary in many abdominal operations and in the removal of fibroids they constitute a needless insult as well.

The operative technique for the treatment of the fibroid uterus that I have the honor to present for your consideration is as follows:

*Incision.* As the size of the tumor decreases with its removal a large incision is unnecessary. Therefore I use the transverse suprapubic incision 3 to 5 inches in length. The transverse incision is the one of election for three important reasons: first because it gives a maximum exposure of the field of operation with a minimum exposure of the abdominal viscera; the intestines lie well protected by the upper flap; second because of the freedom from postoperative hernia; and third because it yields a higher percentage of primary union than does the median dim incision.

The method of making and closing the incision is as follows: With the patient in the Trendelenburg position a transverse incision 2 to 4 inches in length is made in the edge of the suprapubic hair or in the transverse skin fold usually found just above it. A straight cut is used rather than a semilunar one because experience has shown that it severs fewer blood vessels giving rise to less hemorrhage and causing less interference with the subsequent nutrition of the flaps. It is seldom necessary to ligate more than two or three vessels in the wound and often no ligatures at all are needed thus greatly reducing the amount of foreign material in-

troduced into the wound all of which has an important bearing on wound union.

The wound is now stretched with the finger thereby slightly enlarging it and better exposing the underlying fascia. After operation contraction back to the original size of the cut occurs. The fascia is next incised in the same direction and to the same extent 1 to 2 inches above the symphysis pubis. The extent of the fascial incision on either side should be limited by the outer borders of the recti muscles and if a larger opening is required the incision should be curved upward or follow the outer borders of the rectal sheaths directly upward to avoid injury to the external ring. Dissecting the fascial flaps free from the underlying muscles which can readily be done by blunt dissection with the finger (from the linea alba they must be cut with the scissors) discloses the two recti overlapped by the pyramidales. The right pyramidalis is separated by its outer edge from the underlying rectus but not from the linea alba and retracted to the middle line. Under this the rectus is separated from the middle line and retracted outward.

The peritoneum now lies exposed and the abdominal cavity is opened by a vertical incision. The lower flap is retracted by a self retaining retractor preferably that of Doyen and the upper one by a small movable abdominal retractor.

These are the only permanent retractors required. Of great assistance during the remainder of the operation are two Pryor towels which make possible perfect retraction in what would otherwise be inaccessible portions of the operative field and which can be made to illuminate many a dark area with light reflected from their polished concave surfaces.

When the operation is completed the wound is closed in three layers: the peritoneum, fascia and skin. The peritoneum is brought together by a continuous suture of fine silk. The fascia is united by a running quilted suture of medium sized silkworm gut or silver wire drawing the raw edges together without undue tension and instead of being tied the ends are brought out through the

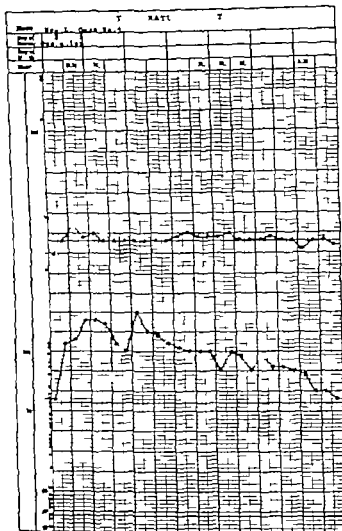


Fig. 1

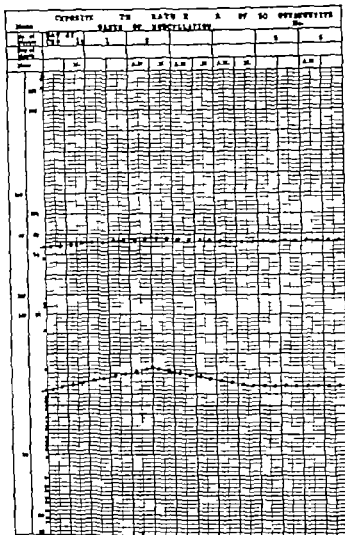


Fig. 2

skin and left long near the angles of the wound. The incision in the skin is closed by a continuous subcuticular stitch of silkworm gut or silver wire and the ends are also brought out long through the skin near the angles of the wound but on the opposite sides from the fascial stitch.

A firm roll of gauze one inch thick and slightly longer than the wound is now laid over it and over this at each end the skin and fascial stitches are fastened together just tight enough to take up any slipping that may have occurred since their introduction. At the first dressing on the second day the gauze between the sutures is cut out so as to allow subsequent daily inspection of the wound.

At the end of the second week the sutures are unfastened releasing the remaining ends

of the gauze roller and the skin stitch is cut off at one end and drawn out. The fascial stitch is removed in a similar manner thus leaving no suture material behind in the wound between the peritoneum and skin.

In case there is failure on the part of the wound to heal by primary union the skin stitch should be withdrawn and the fascial incision inspected. If this shows infection, or if the infection is under the fascia its edges can be readily separated by loosening the suture without removing it, and proper drainage secured. Later when the infection has subsided and union begun the edges of the fascia can again be drawn together and good approximation obtained. Thus the introduction of secondary sutures to close the separation in the fascia, so often observed following suppurating wounds and such a



ABDOMINAL MYOMECTOMY AND HYSTEROMYOMECTOMY BY MORCELLATION  
50 CONSECUTIVE CASES

N	Name	A.	Les on	Associated Les on	Operation	Result	Pathological Report
1	Mrs M B	28	Small tumor	General fibro	Hysteromyomectomy	Cured	
2	Mrs M H		Large tumor some degeneration	General fibro	Hysteromyomectomy	Cured	
3	Mrs H A	31	Multiple tumors (all cross degeneration on one)	Extensive on and adherent to uterus	Myomectomy Round ligaments also cauterized	Cured	
4	Mrs J R	33	Multiple tumors two red pedunculated	Chronic salpingitis	Hysteromyomectomy Salpingectomy	Cured	
5	Mrs T C	37	Single tumor	General fibros adhesions Chronic appendicitis	Hysteromyomectomy Right salpingectomy	Cured	
6	Mrs E L	35	Single tumor	General fibro	Hysteromyomectomy Appendectomy	Cured	
7	Mrs B	40	Single tumor	General fibro	Hysteromyomectomy	Cured	
8	Mrs A G	40	Single tumor nodular, necrotic	Chronic fibro Chronic appendicitis	Hysteromyomectomy Appendectomy	Cured	
9	Mrs M L		Multiple tumors		Hysteromyomectomy	Cured	
10	Mrs C M	38	Multiple tumors	General fibros Ovary	Hysteromyomectomy Appendectomy Oophorectomy Salpingectomy	Cured	
11	Mrs G W	38	Multiple tumors	General fibro Adhesions	Hysteromyomectomy Salpingectomy	Cured	
12	Mrs T McC		Multiple tumors necrotic	General fibro	Hysteromyomectomy Oophorectomy Appendectomy	Cured	
13	Mrs K G		Multiple tumors degenerated some	menstrual prostrum	Hysteromyomectomy Ovario salpingectomy	Cured	
14	Mrs E F	31	Single tumor	Chronic appendicitis	Myomectomy Appendectomy	Cured	
15	Mrs P McD	37	Single tumor	General fibros Adhesions	Hysteromyomectomy Oophorectomy Salpingectomy	Cured	
16	Mrs E H	49	Multiple tumors	General fibro	Hysteromyomectomy Parsalvaginal hysterectomy	Cured	
17	Mrs A C	33	Multiple tumors	General fibros Oophorectomy	Hysteromyomectomy Oophorectomy Salpingectomy	Cured	
18	Mrs M A	31	Single tumor	General fibro	Hysteromyomectomy Oophorectomy Salpingectomy	Cured	
19	Mrs A H	34	Multiple tumors	Extensive on	Myomectomy Round ligaments shortened	Cured	
20	Mrs G T	43	Multiple tumors	General fibro	Hysteromyomectomy Salpingectomy	Cured	
21	Mrs A W	34	Multiple tumors		Hysteromyomectomy Salpingectomy	Cured	Myoma necrotic
22	Mrs J F	30	Multiple tumors	Parenchymatous cyst	Hysteromyomectomy Oophorectomy	Cured	
23	Mrs J H	38	Multiple tumors calcareous degeneration on one		Hysteromyomectomy	Cured	Calcareous degeneration (bilateral necrosis)
24	Mrs D	38	Multiple tumors	Chronic appendicitis Bilateral hematosalpingitis	Hysteromyomectomy Appendectomy Salpingectomy	Cured	
25	Mrs J D	35	Multiple tumors	Adherent adhesions	Hysteromyomectomy	Cured	
26	Mrs A W	47	Multiple tumors	General fibro	Hysteromyomectomy Salpingectomy	Cured	

## ABDOMINAL MYOMECTOMY AND HYSTEROMYOMECTOMY BY MORCELLATION — (Concluded)

No	Name	Age	Les on	Associated Les on	Operat on	Result	Patholog cal Report
27	Mrs J M	37	Multi ple tumors	Chronic appendicitis Retrocervical appendix	Hysteromyomectomy Appendectomy Salpingectomy	Cured	
28	Mrs M E	43	Multi ple tumors	General fibrosis	Hysteromyomectomy	Cured	
29	Mrs A R	45	Multi ple tumors	Chronic appendicitis	Hysteromyomectomy Appendectomy	Cured	
30	Mrs I P	36	Multi ple tumors	Chronic appendicitis	Hysteromyomectomy Appendectomy Oophorectomy Salpingectomy	Cured	
31	Mrs K H	43	Multiple tumors One with twisted pedicle		Hysteromyomectomy	Cured	
32	Mrs M H	36	Multi ple tumors		Hysteromyomectomy	Cured	
33	Mrs R S	43	Multi ple tumors	Adherent adenoma	Oophorectomy Appendectomy	Cured	
34	Mrs C T	46	Multi ple tumors	General fibrosis Secondary adenoma	Hysteromyomectomy Parsuomyectomy	Cured	
35	Mrs A S	54	Single tumor	General fibrosis Hydromyxoma	Hysteromyomectomy Salpingectomy Appendectomy	Cured	
36	Mrs M S	40	Multi ple tumors	General fibrosis	Hysteromyomectomy	Cured	
37	Mrs E S	34	Multi ple tumors		Hysteromyomectomy Salpingectomy Right oophorectomy Appendectomy	Cured	
38	Mrs A F	3	Multi ple tumors		Hysteromyomectomy	Cured	
39	Mrs R C	34	Single tumor		Myomectomy	Cured	
40	Mrs A B	36	Multi ple tumors	Chronic appendicitis	Myomectomy Appendectomy	Cured	One subserosal uterine cavity opened
41	Mrs M R	33	Multi ple tumors	General fibrosis Adherent adenoma Cervical polyp	Hysteromyomectomy Oophorectomy Salpingectomy	Cured	
42	Mrs M N	34	Multi ple tumors	Salpingitis	Hysteromyomectomy Oophorectomy	Cured	
43	Mrs A W	45	Single tumor	Hydromyxoma Oophoroma	Hysteromyomectomy Salpingectomy Right oophorectomy	Cured	
44	Mrs F B	30	Single tumor	Retroflexion Salpingitis	Myomectomy Round ligaments shortened Right salpingectomy	Cured	
45	Mrs O S	47	Single tumor Acute inflammation		Hysteromyomectomy	Cured	
46	Mrs S M	33	Single tumor		Myomectomy	Cured	Tumor of cervical os and retroperitoneal
47	Mrs D B	45	Single tumor	Retroversion Chronic appendicitis	Myomectomy Round and uterosacral ligaments shortened Appendectomy	Cured	
48	Mrs R B	30	Multi ple tumors		Hysteromyomectomy Oophorectomy Salpingectomy	Cured	
49	Mrs A G	3	Multiple tumors	General fibrosis Adherent adenoma Chronic appendicitis	Hysteromyomectomy Salpingectomy Right oophorectomy Appendectomy	Cured	
50	Mrs M S	36	Multi ple tumors Tubercles	Diseased adnexa	Hysteromyomectomy Oophorectomy Salpingectomy Appendectomy	Cured	

frequent cause of postoperative hernia is avoided saving much annoyance to both patient and surgeon.

With the peritoneal cavity open and the wound properly retracted above and below the pathological condition is studied and the question of myomectomy or hysteromyomectomy decided. The tumor mass is then grasped with two heavy traction forceps held in close apposition with the abdominal wall and morcellation begun. Small tumors are nucleated and removed entire while those too large to pass through the incision are divided. The subtotal or total removal of the uterus is greatly facilitated by first removing the fibroid. This decreases the bulk of the tumor mass and as the operation proceeds each successive step becomes progressively easier. With the reduction in size of the tumor comes relaxation of the broad ligaments making their subsequent ligation easy and certain in uncomplicated cases. To fully appreciate what I mean by this it is but necessary to contrast the difficulty experienced in ligating the tense overstretched broad ligaments of a large fibroid uterus *in situ* with the ease attending the same procedure in a case of uterine prolapse where great laxity of the ligament exists. When the growth is a very vascular one or when it is desirable to save all blood possible to the patient as in cases of grave secondary anemia control of the blood supply to the tumor is first obtained by separating the peritoneal reflection of the bladder at the uterus and ligating or clamping the uterine arteries on either side before the actual removal of the growth is begun. By this procedure the blood contained in the tumor returning through the uterine veins is saved to the patient and the operation is easier because of the freedom from bleeding and the shrinkage of the tumor consequent upon its venesection. As a rule the amount of blood lost during removal by morcellation is no greater than by the removal *en masse* it is the residual blood of the tumor only that is lost. During the process of morcellation the tumor mass is kept constantly in contact with the abdominal wall. This excludes the intestines from the field of operation pre-

venting their injury or prolonged exposure and eliminates the traumatism of laparotomy pads. As the operation is largely extraperitoneal the convalescence is proportionately smooth. There is a notable freedom from distention and the danger of subsequent adhesions is minimized. When adherent viscera are encountered they are drawn up into the wound and separated under the eye where they can be easily and safely dealt with. As the morcellation proceeds the tumor decreases in size the round and broad ligaments relieved of tension relax and it now becomes easy when hysteromyomectomy is being done to deliver the uterus through the wound and proceed as in an uncomplicated case.

As an additional argument for the operation described I beg leave to present to you a series of fifty cases from my records with a brief analysis of some of their most salient points. These are consecutive and not selected cases and while the number is comparatively small yet I feel that the series cover pretty well the field of fibroid pathology and gives a very good idea of the value of this technique.

In every one of the cases operated upon the size of the growth would have prohibited its removal *en masse* except through a very large incision. In 23 cases nearly one half the tumor mass reached to or above the umbilicus. In Case 14 the largest and most difficult single fibroid of the series the tumor reached well above the umbilicus entirely filled the pelvic and most of the abdominal cavity. To have removed it entire would have necessitated a median line incision reaching well above the umbilicus many laparotomy pads would have been required and there would have been great exposure and traumatism of the intestines making the convalescence proportionately stormy. Instead a 5 inch Pfannenstiel incision was used no laparotomy pads were required and the only intestinal exposure necessary was for the separation of the adhesions as they were drawn up into the wound. Note how smooth was the convalescence in this case. A maximum elevation of only 1 degree in temperature and 8 beats of the pulse occur

ring on the evening of the operation the temperature was normal on the first day and thereafter. There was no abdominal distention and normal action of the bowels occurred on the third day.

Again in Case 9 a hysteromyomectomy for multiple tumors reaching well above the umbilicus complicated and prolonged by unskilled assistance yet there was only 14 elevation of temperature and 28 beats of the pulse on the same evening normal on the first day and thereafter (see chart Fig. 1).

*Age.* The youngest patient was 27 the eldest 56 the average age being 38 years.

A transverse suprapubic incision was made in all but two cases. In these the patients had been previously operated upon through a median line incision and the same was repeated.

*Complications operative.* Chronic adnexal disease was found in 22 per cent of the cases.

	Cases
Adherent appendix	19
Retropositionment	2
Intraligamentous cyst	2
Fibroids	
Twisted pedicle	2
Acute inflammation	1
Calcareous degeneration	3
Necrosis	4
Early pregnancy	

Myomectomy was performed 9 times and hysteromyomectomy 41 times.

*Of the convalescence.* In one case of pneumonia developed on the tenth day.

The average maximum elevation of temperature and pulse after operation was 0.4 with 11 beats of the pulse occurring on the second day. The average day on which the temperature became normal was the fourth. Primary union in the abdominal wound occurred in every case. There were no deaths.

#### CONCLUSIONS

The advantages of myomectomy or hysteromyomectomy by morcellation are many. The original morcellation by the vaginal route enjoyed great popularity because of the smoothness of the subsequent convalescence and freedom from postoperative complications both immediate and remote. The abdominal removal of these tumors by morcellation now that we have today so improved our abdominal technique gives just as smooth

a convalescence and just as great a freedom from complications as was secured by the vaginal operators in the past.

The advantages of the technique which I have above outlined may be considered both from the point of view of the patient and of the surgeon. To the patient it affords greater safety, a shorter and a smoother convalescence. This is by reason of the fact that as the surgeon works practically extraperitoneally the intestines are kept out of the way without recourse to laparotomy pads; thus is the intraperitoneal traumatism minimized and postoperative shock, distention or peritonitis is seldom if ever seen. In hysteromyomectomy the danger of secondary hemorrhage from slipped ligatures on the broad ligaments is very materially decreased because of the ease and safety with which the relaxed broad ligaments can be ligated. The smaller incision and the stronger resulting scar especially when the transverse incision is used reduces to a minimum the danger of hernia. The high percentage of primary union resulting when the transverse incision closed with non-infectable suture material means a much shorter hospital residence. A large granulating median line incision where primary union has not been secured means a prolongation of the convalescence by many weeks with a good prospect of a subsequent hospital stay when the ventral hernia almost certain to occur in such a case is operated upon.

*The advantages to the surgeon.* During the greater part of the operation the tumor is in contact with the abdominal wall and the work is extraperitoneal. Thus is the surgeon able to see definitely each pathological condition as it arises and to take the necessary time to meet the indication for by this technique the length of time which the patient is under the anesthetic is not nearly of the importance that it is when a large median line incision has been made with all the consequent exposure of intestines and use of laparotomy pads that go with the older technique. Although the transverse suprapubic incision used may be so small as to handicap many an operator at the start still with experience one becomes quickly proficient.



4 Tordens	8 mos	Spindle cell with myxomatous degeneration
Kaufman	0 mos	Rhabdomyoma
Kaufman	1 yr	Round cell with myxomatous and fatty degeneration
Feldington	1 mo	Myxomatous sarcoma
Birch Hirschfeld	yr	Sarcoma
Schalek	3 yrs 3 mos	Mixed cell sarcoma
Kaufman	4 yr	Rhabdomyoma
Levy	4 yrs	Myxomatous sarcoma
Cree	4 yrs	Spindle sarcoma
Sparton	6½ yrs	Myxomatous
Wind	yr	Small spindle cell
Van Der Hoven	6 yrs	Sarcoma
Bland Sutton	yr	Spindle cell
Lambert	8 yrs	Spindle cell
Clemmont	14 yrs	Myxomatous
Crutcher	14½ yrs	Large round cell
Bortle	1 yrs	Spindle cell
Oliva	18 yrs	Small round cell
Bobbio	18 yrs	Mixed sarcoma
Guyon	0 yr	Small round cell
West	1 yr	Spindle cell
Menocal	1 yr	Round cell
Kaufman	4½ yrs	Lymphosarcoma
Stein	yr	Sarcoma
Socin and Burkhardt	20 yr	Rhabdomyoma (malignant)
Compland	20 yr	Lymphoma
Gibson	34 yr	Small round cell
Hugues	3 yr	Round cell
Kaplan	40 yr	Chondrosarcoma
Kaplan	4 yrs	Fibrosarcoma (no malignant)
Burkhardt	0 yr	Angio-sarcoma
Fauchet	yr	Myo-sarcoma (first case)
Socin	31 yrs	Round cell with de calcareous degeneration
Verboogen	3 yrs	Myxomatous calcareous with de degeneration
March	yr	Spindle cell
Sparton	0 yrs	Spindle cell
W. H. H.	0 yrs	Angio-sarcoma
Duprat	3 yrs	Small round cell



Fig Photograph of removed  
Fig Microscopic section of tumor

Gibson List		Descum List
Levy	refers to Socin	Levy and Socin and Burkhardt
Socin	refers to Wind	
Hind	refers to Schalek	
Schalek	refers to Bover	Schalek
Gratzner	refers to Gratzner	

Gibson in addition credits the following cases as authentic not found in Descum's list

Reported by	Age of Patient	Type of Tumor
4 Borth	113	Myxosarcoma
43 Botescu	2 yrs	Angiosarcoma
44 Stern	4 yrs	Small round cell
45 Power	60 yrs	Small round cell
46 Gibson (2d case)	36 yrs	Small round cell
4 Cabot A T	Not stated	Not stated
48 Cabot A T	yr	Small spindle cell
49 Depage	2 yrs	Small round cell

In Power's list are three to be added not included in either previous lists

Reported by	Age of Patient	Type of Tumor
50 MacGowan	Not stated	Not stated
1 Conforti	4 yrs	Lymphosarcoma
2 Ibid	yr	Small round cell

In addition to the above lists the writer has collected the following including the case reported

Reported by	Age of patient	Type of tumor
53 Kehrer	yr	
54 Toquechel	yr	Round cell
55 Jaramitto	22 yr	Fibrosarcoma
56 Hiescher	34 yrs	Small spindle cell
57 O good	yr	Small spindle cell
58 Squier	40 yr	Rhabdomyoma
59 Parmenter	69 yrs	Small spindle cell

The tumor types in these 56 cases were as follows

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1 Kehrer case the wrong report was seen from the Surgeon General's office thereof the type of tumor was not noted. The patient was mentioned by another author

It is questionable if Levy's case of fibrosarcoma should be included in Descum's list as one of prostatic sarcoma and the writer has been unable to determine just why it was. Comparing Gibson's and Descum's list certain discrepancies exist in the spelling of a number of names which evidently refer to the same person.

To bring the number of reported cases to date therefore the following names in each list are believed by the writer to be one and the same



villier's fascia and involves the rectum only late and high up. The inguinal lymph nodes are enlarged and a node situated at the outer tip of the seminal vesicle is usually the first to enlarge and may be palpable through the rectum. The tumor almost never attains the size of sarcoma.

The age of the patient and the relatively slow course of the disease are of aid in diagnosis.

#### TREATMENT

So far no case has recovered. An early diagnosis and complete extirpation of bladder prostate and vesicles with transplantation of both ureters may offer a very slim chance.

In infants such a procedure would hardly be possible.

In conclusion I wish to thank Dr R. N. DeNard for examination of the blood. Dr

Julius Richter for photographs and Dr Burton T. Simpson for his pathological report.

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## THE VARIATIONS IN THE BLOOD SUPPLY OF THE OVARY AND THEIR POSSIBLE OPERATIVE IMPORTANCE<sup>1</sup>

By JOHN A. SAMPSON M.D. ALBANY, NEW YORK

IN conservative operations on the pelvic organs of women the object of the surgeon should be not only to save ovarian tissue but to leave it in such condition that it may properly perform its function and may not later cause discomfort to the patient. In order to accomplish this a knowledge of the blood supply of the ovary is of importance. The surgeon should consider not only the actual blood supply of the ovary but especially its potential for in these operations the actual blood supply may be more or less disturbed and must be replaced by the potential. The present study was undertaken for its anatomical interest and also for a better knowledge of the blood supply of the ovary as bearing on operations in which a tube is removed without removing the ovary or of that side or the uterus, removed leaving one or both ovaries. The intrinsic blood vessel of

the ovary and resection of that organ are not considered. The intrinsic blood vessels of the ovary have been very carefully described by Clark.<sup>2</sup>

The material for this study consisted of six foetal tubes and ovaries and thirty adult ones in which the arteries had been injected with bismuth and ten adult tubes and ovaries in which the veins had been thus injected. In the foetal specimens the arterial supply of the entire foetus was injected. In the adult ones the uterus with appendages was injected and these specimens were for the most part obtained at operation—a few at postmortem.

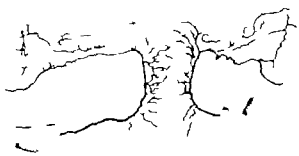
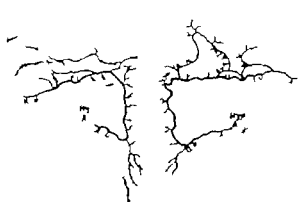
#### METHOD

The injection mass used was 10 to 15 per cent gelatin which contained in suspension

<sup>1</sup>See Contribution to the Science of Medicine. The Johns Hopkins Press, 1900.

<sup>2</sup>Read before the American Gynecological Society, Washington, May, 1914.





The uterine artery is the main source of blood supply to the uterus and is derived from the anterior division of the internal iliac artery. It runs along the anterior surface of the broad ligament and gives off branches to the fundus and body of the uterus. The ovarian artery is the main source of blood supply to the ovary and is derived from the abdominal aorta. It runs along the posterior surface of the broad ligament and gives off branches to the ovary and the suspensory ligament.

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bismuth subcarbonate The specimen was first submerged in a basin of warm water and the arterial or venous system injected with the melted mass. The injected specimen was placed in cold water until the gelatin had solidified and afterwards preserved in Kaiserling's solution or 10 per cent formalin.

In order to compare the blood supply in the different specimens prints were made from the negatives some on Repro paper and others as bromide enlargements. The course of the vessels was traced with water proof ink on the prints using the stereoscope as a guide and taking the liberty to draw vessels to one side as in dissecting and to leave out irrelevant branches the object being to show the vessels desired in one plane so that they would not be confused with each other. The prints on Repro paper were then bleached leaving the tracing in ink. Bromide enlargements separate the individual vessels from each other and by intensifying the vessels to be studied with ink their course can be followed and compared in different specimens much as in the prints which are bleached. These tracing supplemented with the stereoscope furnished an

Stereoscopic roentgenograms were made for the purpose of studying the course of the individual vessels. Lantern slides made from



Fig. 3. Arterial supply of uterus, tubes and ovaries of fetus 44 cm long  $\times 1\frac{1}{2}$ . Bronzed enlargement as in Figs. 1 and 2.

The course and distribution of the right uterine and ovarian arteries is similar to the ovarian and uterine arteries in Fig. 2. The left uterine and ovarian arteries differ from the right in that the usual utero-ovarian anastomosis is not present.

The actual blood supply of the ovaries is similar to the blood supply of the ovaries in Fig. 2 except for the absence of the arteria utero-ovarium communica on the left side. The origin and distribution of the tubal arteries is similar to those in Fig. 2.

The arteries proper of the various organs and structures are further developed than in Fig. 2 and in this further development there arises a freer communication between the uterine and ovarian arteries of same side and thus a better demonstration of their value as a potential blood supply of the ovary.

easy and accurate means of studying the blood supply of the ovary and detecting its variations.

I am indebted to Dr. Tiffany, Lawyer for helping me inject the specimens to Dr. J. M. Berry and Dr. William Howard of the Radiographic Department of the Albany Hospital for the X-ray features of the work. Mr. J. A. Glenn for making the photographs and prints and Dr. W. M. Baldwin, Professor of Anatomy in the Albany Medical College for the nomenclature of the arteries.

#### THE DEVELOPMENT OF THE ACTUAL AND POTENTIAL BLOOD SUPPLY OF THE OVARY.

In the study of the arterial supply of the uterus, tubes and ovaries of a human fetus 26 centimeters long one could follow the course and distribution of the uterine and ovarian arteries and variations were found in the two sides and thus variations in the blood supply of the corresponding appendages (see Fig. 1). Each uterine artery arose from



Fig. 4. Arterial supply of the uterus, tubes and ovaries.  $\times 1\frac{1}{2}$ . Radiograph of autopsy specimen, arteries injected with bismuth.

The general course and distribution of the uterine and ovarian arteries is well shown but it is impossible to determine the exact distribution of these vessels on account of the richness of the arteries proper of the pelvic organs and the confusion resulting from viewing in one plane vessels which occur in many (see Figs. 6 and 7).

the hypogastric, and on approaching the uterus divided into an ascending branch running along the side of the uterus and a descending one supplying the cervix.

The ascending branch gave rise to the arteria uteri proper supplying the body of the uterus and a fundal branch at the uterine cornu where the uterine artery changed its direction and passed between the layers of the broad ligament to anastomose with the ovarian artery of that side. In its course from the cornu of the uterus to the hilum of the ovary it gave rise to a tubal branch (arteria tube intermedia) and terminated in the utero-ovarian branch which anastomosed with the ovarian.

The right ovarian artery on approaching the ovary furnished branches to that organ and anastomosed with the ovarian branch of the uterine.

The left ovarian artery on approaching the ovary divided into two branches, a lateral one (tubo-ovarian) supplying the distal portion of the tube and the distal pole of the ovary and a medial one supplying the ovary and anastomosing with the utero-ovarian branch of the uterine.

The actual blood supply of the ovary was evident, i.e. ovarian and uterine. The potential suggested itself in the well known

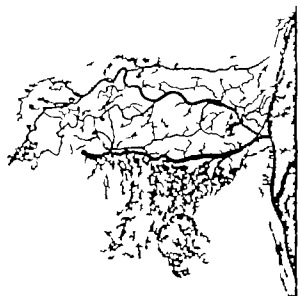


Fig 5 Arterial supply of left tube and ovary and broad ligament showing another type of anastomosis of uterine and ovarian arteries and all the richness of arterial supply of broad ligament.  $\times 11$ . It is a radiograph of operative specimen. The arterial supply of the broad ligament has been traced with ink so that fine branches could not be lost. The reproduction printed is bleached.

The branches arising from the terminal portion of the uterine artery differ slightly from the preceding; the arteries proper are mainly the arterial tube intermediate arises from the terminal branch nearer the uterus than in the preceding; the branch of the broad ligament arises from the intermediate instead of the terminal; terminal as usual terminates in the utero-ovarian.

The ovarian differs from that in Fig. 6 in the absence of lateral or distal branch. The main distal terminus is such as that of a distal branch which is main and which terminates.

The actual blood supply of the ovary is terminal and ovarian; the arterial proper arising from the utero-ovarian anastomosis in line instead of group as in the preceding specimen.

The arterial tube medial is insignificant. The terminal arises from the terminal; the body of the uterus and the lateral branch of the terminal; but differs from the lateral. Fig. 7 in that arterial proper do not arise from it. The blood supply of the tube entirely uterine.

The blood supply of the broad ligament is especially well injected in this specimen. It also is rich in its origin from many sources and the free communication between its branches and thus the importance of the preservation of the broad ligament conservative surgery as a source of potential blood supply to the ovary.

utero-ovarian anastomosis and in the blood supply of the tube.

The blood supply of the right tube was entirely uterine; the arterial tube medial was derived from the fundal; the arterial

tube intermediate from the uterine between its fundal and ovarian branch and the arterial tube lateral from the intermediate.

The blood supply of the left tube was partly uterine and partly ovarian. The medial and intermediate had origins similar to those of the right tube but the lateral arose from the ovarian.

In this divided blood supply of the tube, i.e. both uterine and ovarian, we see the possibilities of the development of a potential blood supply of the ovary by means of establishing a communication between the ovarian and uterine arteries through the arteries of the tube.

In the study of the arterial supply of the uterus, tubes and ovaries of an older foetus (40 centimeters long) a further development of the blood supply of these organs especially of the arterial proper was found (see Fig. 2).

The course and distribution of the ovarian arteries were similar to the left ovarian artery in the preceding specimen. The actual blood supply of the ovary was definitely ovarian and uterine; the arterial proper arose from the utero-ovarian anastomosis. The potential blood supply of the ovary was evident in the free anastomoses of the tubal arteries thus establishing a communication between the ovarian and uterine arteries hinted at in the preceding specimen. The arterial tube medial arose from the fundal artery; the intermediate from the uterine between the fundal and the utero-ovarian and the lateral from the ovarian and branches from these vessels communicated with each other along the side of the tube and through the lateral branch of the intermediate which supplied the broad ligament.

In a specimen from a still older foetus (44 centimeters long) a further development of the arterial proper was found and an interesting variation in the blood supply of the left ovary was encountered (see Fig. 3).

The course and distribution of the right uterine and right ovarian artery were similar to the preceding. The left uterine and left ovarian differed from the right in that while arterial proper arose from them the anastomosing branch (the arterial utero-ovarian communications) was absent.

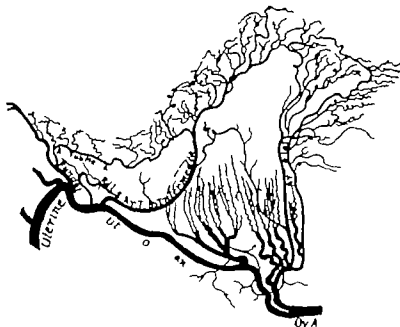


Fig 6 Tracing of arterial supply of the left tube and ovary shown in Fig 4. Most frequent type of distribution of uterine and ovarian arteries (24 of 30 specimens) X

Tracing of radiograph in which under guidance of stereoscope confusing branches were omitted and others when necessary were drawn to one side as in dissecting so that as far as possible all those traced may appear in one plane. The uterine and ovarian arteries were purposely made heavier than in the print and the arteries ovarii propriae are indicated schematically. The print was then bleached leaving the tracing.

The branches arising from this portion of the uterine artery are as follows: arteria uteri propria including fundal branch, branch to round ligament, arteria tubae intermedia and the terminal ovarian branch communicating with the ovarian artery.

The branches arising from the ovarian are the tubo ovarian supplying the distal portion of the ovary and tube

and the ovario uterine which with the utero ovarian supplies the proximal portion of the ovary.

The arterial blood supply of the ovary is partly ovarian and partly uterine the ovarian apparently predominates.

The arteria tubae media arises from the fundal (uterine) the arteria tubae intermedia arises from the uterine and the arteria tubae lateralis from the tubo ovarian branch of the ovarian which as already stated supplies the distal portion of the ovary. The tube also has a divided blood supply the greater portion being uterine and the distal portion ovarian. These tubal arteries anastomose with each other as also do some of the arteriae tubae propriae.

The blood supply of the broad ligament is partly uterine especially through the tubal arteries and that of the round ligament and partly ovarian branches from these anastomose with each other.

The potential blood supply of the ovary is indicated in the divided blood supply of tube and broad ligament i.e. uterine and ovarian with communications between the two

The distal pole of the right ovary was supplied by the tubo ovarian branch and the ovarian and the proximal pole by the ovarian branch of the uterine the arteria utero ovariana communicans being present. The left ovary had a similar blood supply but the communicating artery as stated was absent.

The blood supply of the tube was similar to that in the preceding specimen.

The potential blood supply of the right ovary is evident in the communicating artery and in the free anastomosis of the tubal arteries.

The absence of the communicating artery between the uterine and ovarian artery on the left side and the communication between the tubal arteries of uterine and ovarian origin emphasizes the importance of the tubal ar

teries as a potential factor in the blood supply of the ovary. The still further development of the potential blood supply of the ovary was well shown in the adult specimens (see Figs 5 6 and 7).

In all the adult specimens the actual blood supply of the ovary was derived from the uterine and ovarian. The ovarian communicated with the uterine not only through the utero ovarium communicans but also through the vessels of the tube and broad ligament. The tubal arteries anastomosed with each other as in the fetus the arteriae tubae propriae were further developed and in places in the outer wall of the tube communicated with each other. In twenty four of the thirty specimens the tube had a divided blood supply the arteria tubae lateralis

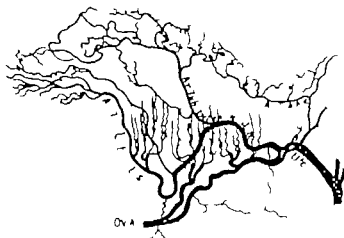


Fig. Arterial supply of the right tube and ovary shown in fig. 4. Type of variation in distribution of lateral and ovarian vessels occurring in 4 of 3 specimens X. Tracing of radiograph as in fig. 6.

The branches arising from this portion of the uterine artery are similar to the preceding but the final distribution differs as will be considered later.

The ovarian differs in its branching from the preceding, the tubal branch being absent. The ovarian divides into two branches, lateral one supplying the central portion of the ovary and medial one which with the uterine artery supplies the proximal portion of the ovary.

The actual blood supply of the ovary is partly ovarian and partly uterine; the uterine apparently predominating

the distal pole is supplied by branches from the arteria tubae lateralis; the latter branch of the arteria tubae intermedia (uterine) the middle portion by the ovarian and the proximal by the arteria uterina; the arteria ovarii propria arising groups.

The arteria tubae medialis arises from the fundal (uterine) the arteria tubae intermedia from the uterine and the arteria tubae lateralis from the intermedia. The arteria tubae lateralis takes the place of the tubo-ovarian artery of ovarian origin in preceding illustration. The blood supply of the tube is entirely uterine but through the blood supply of the broad ligament branches from the ovarian artery communicate with similar branches from the tubal arteries.

arising from the ovarian artery, the remaining branches from the uterine. In the six specimens in which the lateralis was also of uterine origin branches from this vessel anastomosed with branches from the ovarian supplying the broad ligament. The broad ligament received its blood supply from branches of the uterine, ovarian and tubal arteries and many of these communicated with each other. The pelvic portion of the round ligament received its nutrient vessel from the uterine or one of its branches (see description later) and thus also supplied the adjacent portion of the broad ligament. The importance of the tube, broad ligament, round ligament and ovarian ligament as a source of blood supply (potential) to the ovary is evident.

#### VARIATIONS IN THE COURSE AND DISTRIBUTION OF THE UTERINE ARTERY IN THE 30 ADULT SPECIMENS

The course of the uterine artery along the side of the uterus with minor variations in the origin of the arteria ovarii propria was

similar in all specimens. At a varying distance (from 1 to 2.5 centimeters in the hardened specimen) below the tube the uterine artery passed between the layers of the broad ligament toward the hilum of the ovary and terminated in the ovarian branch. Variations were present in this portion of the uterine artery. In twenty one instances the arteria tubae intermedia arose from the uterine between the fundal branch and the ovarian branch more frequently nearer the fundal than the ovarian considering the origin of the ovarian; the place where the first arteria ovarii propria arose from the uterine. In eight instances the arteria tubae intermedia arose from the fundal branch and in one from an artery (epigastric) in the round ligament the latter also supplying the fundal branch. (See blood supply of tube.)

The artery to the round ligament sometimes arose from the uterine between the fundal and intermedia when the latter arose from the uterine; in others from the intermedia or fundal. (See blood supply of round ligament to be considered later.)

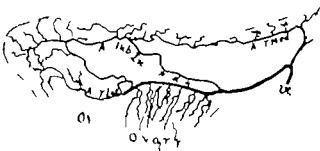


Fig 8 Arterial supply of tube and ovary showing more frequent form of branching of terminal portion of uterine artery. Tracing of radiograph of injected specimen subsequently bleached.

In 21 of the 30 specimens the arteria tubæ intermedia arose from the uterine between the fundal branch and the ovarian as in Figs 5, 6 and 7, and in present illustration — in this instance its place of origin is further from the uterus than in the preceding.

In 24 of the 30 specimens the ovarian divided into a lateral tubal branch and a mesial ovarian — in 11 of these arteria ovarii propria did not arise from the lateral branch. Compare with Fig 9.

The uterine directly or indirectly through its branches supplied a varying portion of the ovary in all the entire tube in six the greater portion of the tube in twenty three the round ligament and greater portion of the broad ligament in all but one.

#### VARIATIONS IN THE COURSE AND DISTRIBUTION OF THE OVARIAN ARTERY IN THE 30 ADULT SPECIMENS

In twenty four specimens the ovarian artery divided into two main branches on approaching the ovary, a lateral tubo ovarian or tubal branch and a mesial ovarian, the latter anastomosing with the ovarian branch of the uterine. Thirteen of the twenty four lateral branches were tubo ovarian — arteria ovarii propria arising for them. In eleven it was apparently entirely tubal although some of this number arteria ovarii propria may have been injured when the uterus was removed and therefore not detected in the injected specimen.

In six specimens the lateral tubal branch of the ovarian was absent. The ovarian artery directly or indirectly through its branches supplied a varying portion of the ovary in all the distal portion of the tube in twenty three and portions of the broad ligament in all but the latter to a lesser degree than the uterine.

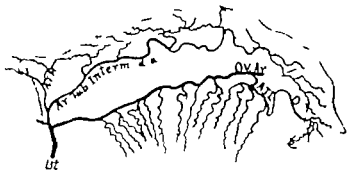


Fig 9 Arterial supply of tube and ovary showing less frequent form of branching of terminal portion of uterine artery. Tracing of a radiograph subsequently bleached.

In 8 of the 30 specimens the arteria tubæ intermedia arose from the fundal instead of the main uterine artery between the fundal and ovarian branch. Compare with Fig 8.

In 24 of the 30 specimens the ovarian divided into a lateral tubal branch and a mesial ovarian in 13 of these the lateral branch was tubo ovarian as arteria ovarii propria arose from it as in this instance.

#### THE ACTUAL BLOOD SUPPLY OF THE OVARY IN THE 30 SPECIMENS

In all it was derived from the ovarian and the uterine artery.

In twenty one specimens the arteria ovarii propria (from 4 to 14 in number) arose from the utero ovarian anastomosis (arteria utero ovarium communicans see Fig 5). Judging by the angle of origin of the arteria propria from this vessel the part played by the uterine and ovarian artery in the nourishment of the ovary varied in some the ovarian predominating in others the uterine. In all of the above it may be said that the proximal portion of the ovary was supplied by the uterine and the distal by the ovarian.

In five instances the proximal portion of the ovary was definitely supplied by the uterine or utero ovarian and the distal by the ovarian with the arteria utero ovarium communicans uniting the two (see Fig 6). In none of the adult specimens was the communicating artery absent as shown in the left side of the foetal specimen (Fig 3).

In four of the six specimens in which the arteria tubæ lateralis arose from the arteria tubæ intermedia (uterine) and not from the ovarian the arteria tubæ lateralis took the place of the tubo ovarian branch of the ovarian furnishing arteria ovarii propria to the ovary. In these four instances the distal



The arterial supply of the tube and ovary shows peculiarities in the division of an artery into lateral tubal and medial ovarian branches; the former entirely tubal. Tracing of radiograph subsequently bleached.



pole of the ovary was supplied by the tubal artery (uterine) the middle portion by the ovarian and the proximal by the uterine or utero-ovarian with anastomosis between the ovarian and uterine arteries (see Fig. 11, 12 and 13).

In all thirty specimens it can be seen that the arterial supply of the ovary is divided into ovarian and uterine with a balanced communication between the two vessels not only through the arterial communications but also through the blood vessel of the tube (arterial tube and arterial tube proper) and through the arteries supplying the broad ligament. The balanced blood supply, apparently of value to the nourishment of the ovary in all instances and especially when there is a marked line of division between the ovarian and uterine blood supply of the ovary as occurred in nine instances and most evident when the distal pole of the ovary was supplied by the tubal artery.

### THE ARTERIAL BLOOD SUPPLY

The tube was usually supplied by three arteries: arterial tube medial, arterial tube intermediate and arterial tube lateral. The arterial tube medial arose from the fundal branch of the uterine and supplied a varying portion of the isthmus of the tube; its size varied inversely with that of the intermediate distal branches from it anastomosed with proximal branches of the intermediate and proximal ones with those of the arterial uteri proper. The intermediate—the largest of the three—arose from the uterine at varying points between the side of the uterus and the hilum of the ovary in twenty-two specimens from the fundal branch in seven

specimens. Arterial supply of the tube and ovary also included distal pole of ovary supplied by lateral artery of tube of uterine or tracing of radiograph—broad ligament and uterine omitted—subsequently bleached.

The middle portion of the ovary supplied by the uterine the middle by the ovarian and the distal by branches from the lateral artery of the tube which is of terminal nature of ovary in 4 of 30 specimens.

The arterial tube terminal arises from the uterine near the uterus and the uterine tube lateral from the intermediate. The lateral supplies the distal pole of the ovary. The course of the arterial tube intermediate along the tube is such that it could be difficult to cut and injure it. Removal of the tube and thus cut off the actual blood supply to the distal pole of the ovary. This could probably not result in harm if the potential blood supply in the broad ligament as not relied upon as through these arterial uterine and tubal arteries common cut off the blood flow through them.

in the form of an artery in the round ligament (epi-uterine) in one. It passed diagonally upward and inward between the layers of the broad ligament toward the under surface of the tube where it divided into two branches: a mesal one going toward the uterus and communicating with a branch of the medial—a lateral one passing toward the fimbriated extremity to anastomose with a similar branch from the laterals. This was the most important tubal artery and varied inversely in size with that of the medial and laterals. Besides nourishing the greater portion of the tube it supplied branches to the broad ligament and frequently gave rise to the round ligament artery and in four instances supplied the distal pole of the ovary through its lateral branch.

The arterial tube lateral arose from the ovarian artery in twenty-four specimens and the intermediate in six. Next to the intermediate it was the largest tubal artery. It supplied the distal portion of the tube including the fimbriated extremity and adjoining

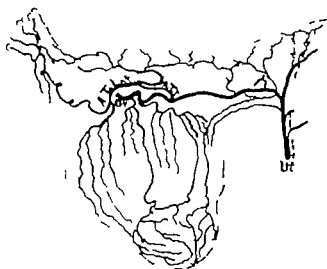


Fig. 12 Arterial supply of tube and ovary showing distal pole of ovary supplied by lateral artery of tube of uterine origin. Tracing as in Fig. 11. The proximal and middle portion of the ovary is supplied by branches from the utero-ovarian anastomosis, the distal portion through the lateral artery of the tube which is of uterine instead of ovarian origin.

The *arteria tubæ intermedia* arises from the uterine near the ovary instead of near the uterus as in Fig. 11. The *arteria tubæ lateralis* arises from it and supplies the distal pole of the ovary.

The course of the *arteria tubæ intermedia* and *lateralis* is such that if care is taken there is much less danger in injuring the actual blood supply of the distal pole of the ovary in removing the tube than in the specimen shown in Fig. 11.

The tube in this specimen is supplied by five tubal arteries instead of three, there being two supplementary *arteria tubæ intermedia* near the isthmus of the tube.

portion of the broad ligament and anastomosed freely with branches of the *intermedia* and *ovarian*.

Minor variations in the number of tubal arteries were found. In three specimens two intermediate arteries were present, and in one instance two mediate.

The *arteria tubæ propria* arose from the tubal arteries and branches from these anastomosed with each other in the outer wall of the tube.

In twenty three instances the blood supply of the tube was divided, the greater portion being uterine and the distal portion ovarian. In six instances it was entirely uterine, in one instance epigastric and uterine. In all instances branches of the ovarian communicated with those of the uterine, either through the tubal arteries or when the blood supply of the tube was entirely uterine through the arteries of the broad ligament.

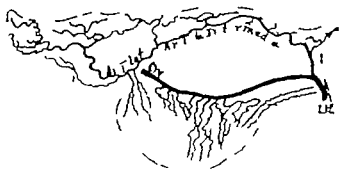


Fig. 13 Arterial supply of tube and ovary showing distal pole of ovary supplied by lateral artery of tube of uterine origin. Tracing as in previous illustration.

The proximal and middle portion of the ovary is supplied by branches from the utero-ovarian anastomosis, the distal portion from the lateral artery of the tube which is of uterine instead of ovarian origin.

The *arteria tubæ intermedia* arises from the fundal branch of the uterine and the *arteria tubæ lateralis* arises from the *intermedia* and from the latter *arteria ovarii* proper to the distal pole of the ovary.

The origin and course of the *arteria tubæ intermedia* is such that it would be impossible to remove the tube without cutting off the actual blood supply to the distal pole of the ovary. It is important to preserve the potential blood supply of the ovary by not removing the tube unless necessary and if so with the least possible encroachment upon the broad ligament. For blood vessels of broad ligament see Fig. 5.

**Broad ligament** The arterial supply of the broad ligament was derived from the uterine and ovarian (one instance partly epigastric through the round ligament). All three tubal arteries contributed branches to the broad ligament, especially the *intermedia* branches also arose from the main trunk of the uterine and from the ovarian. The uterine through its branches contributed more to the blood supply of the broad ligament than the ovarian.

The uterine branches supplying the broad ligament communicated with similar branches from the ovarian, this was especially true in the portion of the broad ligament between the hilum of the ovary and the tube.

Through these utero-ovarian anastomoses the broad ligament must be considered an important source of potential blood supply of the ovary.

**Round ligament** According to the anatomical textbooks the round ligament as it passes through the internal ring receives a branch from the deep epigastric artery.

In most of the specimens the round ligament was clamped close to the uterus in removing the latter, this procedure inter-



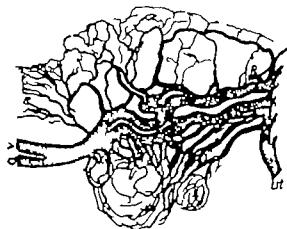


Fig. 14 Venous outlet of tube, ovary and broad ligament. Tracing of radiograph as in previous illustrations.

The venous outlet of the ovary is divided one, partly ovarian through the ovarian veins (*OV*) and partly uterine through the uterine plexus of veins (*U*).

The veins of the tube and broad ligament anastomose freely with each other and are of importance as potential venous outlet to the ovary if either of the actual outlets is in any way disturbed. In addition a vein (*R*) the round ligament unites the utero ovarian plexus with the epigastric vein.

ferred with the injection of the round ligament from the uterine vessels in these specimens.

In ten specimens I was able to detect the artery to the pelvic portion of the round ligament. In five it arose from the uterine artery between the fundal branch and the intermediate tubal artery in three from the intermediate artery and in two from the fundal. Branches from the round ligament artery also supplied the adjacent portions of the broad ligament. This artery accompanies the round ligament toward the internal ring and I judge must communicate with a branch of the epigastric artery. In one specimen a large artery from the round ligament gave rise to the arteria tubae intermedia and also supplied the fundal—these two branches from the uterine being absent. This artery was apparently of epigastric origin.

The round ligament must also be considered a source of potential blood supply to the ovary.

**Utero ovarian ligament.** Arterial branches pass from the arteria ovarii propria through this ligament to the uterus and from the uterine artery or its branches to the ovary.

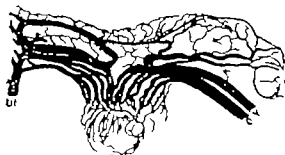


Fig. 15 Venous outlet of tube, ovary and broad ligament. Tracing of radiograph as in previous illustration. The division of the venous of the ovary into an ovarian and uterine outlet is more marked than in the preceding illustration.

#### THE POTENTIAL BLOOD SUPPLY OF THE OVARY

The actual blood supply of the ovary is both ovarian and uterine. The blood supply of the broad ligament being both uterine and ovarian the usual blood supply of the tube being both uterine and ovarian and as the vessels of the broad ligament communicate with each other and with those of the tube and round ligament and as the tubal branches communicate with each other all these structures must be looked upon as containing a potential blood supply to the ovary.

#### THE VENOUS OUTLET OF THE OVARY

Most of the *venae ovarii propriae* empty into the venous plexus (utero ovarian) situated between the layers of the broad ligament a few empty into the uterine plexus (along the side of the uterus). The utero ovarian plexus receives venous blood from the fundus uteri, tube, ovary and broad ligament and is drained by the ovarian veins, the uterine veins (through the uterine plexus) and the epigastric through a vein which accompanies the round ligament.

The course of the *venae ovarii propriae* on leaving the ovarian tissue is partly lateral toward the suspensory ligament of the ovary and partly medial toward the uterus. A division into an ovarian and uterine outlet is more marked in some instances than in others.

The actual venous outlet of the ovary resembles the arterial supply in being partly ovarian and partly uterine in varying proportions.

The potential venous outlet of the ovary is evident in the various communications between the venous channels of the utero ovarian plexus the free anastomosis of the veins of the broad ligament and tube and the communication of the plexus with the epigastric vein of the round ligament

#### CHANGES IN THE OVARY DUE TO INTERFERENCE WITH ITS BLOOD SUPPLY

It is not the purpose of this communication to discuss the changes in the ovary due to interference with its blood supply except very briefly. Clinical experience has shown that conservative ovarian surgery is often followed by enlargement of the ovary due to cystic changes and oedema and that these changes may cause discomfort and necessitate another operation. This has discouraged many operators in the attempts to save the ovary in salpingectomy and hysterectomy. For a fuller discussion of this phase of the subject I would refer to the sections on ovarian conservation after salpingectomy and hysterectomy in Norris *Gonorrhoea in Women*.<sup>1</sup>

I wish to quote one paragraph from the above as it has special bearing on this present work.

Clark has shown that the primordial follicles that usually develop in the substance of the ovary reach the surface as the result of two factors namely increase in size and the fact that they are pushed to the periphery by the constant pulsation of the ovarian arteries behind them. It would be safe to assume that when the ovarian circulation is impaired the ovarian arteries pulsate with less force so that although the maturing follicle might reach the periphery of the ovary the arteries would not possess sufficient pulsating force to produce a necrosis of the tunica albuginea, lying between the follicle and the surface, which, in the normal ovary occurs just before the rupture of the follicle. Under such circumstances the follicle coming in contact with the dense and perhaps thickened tunica albuginea, would fail to rupture and result in a retention cyst. This the author believes to be one of the chief reasons why cystic degeneration follows impairment of the blood supply in this locality. The perioophoritis which results in thickening of the capsule of the ovary that is often present and the impairment of the return venous circulation as suggested by Brown which causes oedema, are also contributing factors.

#### THE INFLUENCE OF SALPINGECTOMY ON THE BLOOD SUPPLY OF THE OVARY

We must consider the above in relation to the normal variations in the actual blood supply of the ovary and tube.

GROUP I Distal portion of the ovary supplied by the ovarian and proximal by the uterine or utero ovarian the arteria tubæ lateralis to distal portion of tubal arising from the ovarian and arteria utero ovarium communicans present—24 of 30 specimens (see Fig 6)

GROUP II The arteria tubæ lateralis arising from the arteria tubæ intermedia (uterine) and not from the ovarian—the distal portion of the ovary being supplied by branches from the arteria tubæ lateralis (uterine) the middle portion from the ovarian and proximal from the uterine or utero ovarian the arteria utero ovarium communicans present—4 of 30 specimens (see Figs 7 11 12 and 13)

GROUP III Arteria tubæ lateralis arising from the arteria tubæ intermedia but not supplying the ovary the distal portion of the ovary supplied by ovarian and proximal by the uterine or utero ovarian the arteria utero ovarium communicans present—2 of 30 specimens (see Fig 5)

In only one instance was the arteria utero ovarium communicans absent and that in a foetus (see Fig 3)

In all salpingectomies the potential blood supply of the ovary is impaired and this impairment is increased the more the broad ligament is encroached upon. The actual blood supply is impaired if the uterine or ovarian artery or branches of same supplying the ovary are occluded or arteriae ovarii propriae are injured the danger of doing this varies with the type.

In Group III there is little danger of injuring the actual blood supply of the ovary if ordinary care is exercised.

In Group I the danger is greater because in freeing the distal portion of the tube it is necessary to ligate the arteria tubæ lateralis and in this group it arises from the ovarian and furthermore arteriae ovarii propriae arose from this branch in thirteen of the twenty four cases. I believe through errors

in technique I failed to inject the arteria ovarii propria arising from this branch in several instances and therefore the true number should have been more than thirteen

In Group II where the arteria tubi lateralis arises from the uterine and supplies the distal pole of the ovary the dangers of shutting off the actual blood supply to this portion of the ovary are great unless care is exercised and the tube is removed with the least possible disturbance of the broad ligament

I do not know of any way of determining the type of arterial supply at the time of operation which would be especially true in pathological conditions of the tube It is obvious that in removing the tube the surgeon should keep as close to the tube as possible and avoid mass ligatures of the broad ligament Even with these precautions the blood supply of the distal pole of the ovary would be injured if it was supplied by an arteria tubi lateralis of intermediate (uterine) origin and the latter from the fundal artery as in Fig 13

In hysterectomy with conservation of one or both ovaries the blood supply from the uterine artery is cut off and the supply to the ovary is lessened in all cases and actually

shut off from the distal pole of the ovary when the latter is supplied by the uterine (4 of 30 specimens) except as it would gain access to this portion of the ovary through the blood vessels of the broad ligament and tube The arteria utero ovarium communicates when present would supply blood to the proximal portion of the ovary but would not supply the distal pole in the above mentioned group The communications between the arteries of the tube and broad ligament of uterine and ovarian origin (the potential blood supply) would soon adjust themselves to the change and the entire ovary would be supplied in all instances if the tube and broad ligament are not removed

As it is impossible to determine at operation the type of ovarian blood supply present these studies support the practice of not removing the tube or tubes in hysterectomy with conservation of the ovaries This was advocated by Dickinson in 1911 I have been following this plan since 1909 and have not encountered any ill effects from not removing the tubes and my clinical results have encouraged me in the practice of conservation of the ovaries under these conditions

GYN & O 99

CHRONIC GASTRIC AND DUODENAL ULCER

By ROBERT C. COLLEY, M.D., F.A.C.S., PORTLAND, ORE.

A STUDY of the literature on chronic gastric and duodenal ulcer leads us to conclude:  
1. The primary cause of peptic ulcer is probably an infection carried from a septic focus in some other part of the body by way of the blood stream to the stomach where it effects a lodgment and so devitalizes the tissues that they fall a prey to the digestive action of the gastric juice. An ulcer is the result. Enough of the organisms seem to remain in the wall of the ulcer in many instances to keep the vitality of the tissues permanently lowered. The irritation seems to create a spasmodic action of the pylorus which at the same time shuts up the acid in the stomach for an abnormally long time thus increasing its corrosive action.

2. While realizing that peptic ulcer is not altogether a surgical condition, it is quite certain that 50 per cent or more of true chronic gastric and duodenal ulcers may be better and more safely treated by surgery than by medical means. The mortality of gastric and duodenal ulcers by medical treatment can apparently not be determined with any degree of accuracy. The mortality as the direct result of surgical treatment ranges all the way from 2 per cent to 12 per cent, or more depending upon the skill of the surgeon for there is probably no place in surgery in which the skill, experience and judgment of the surgeon count for more than in the surgical treatment of chronic gastric and duodenal ulcer.

Concerning the ultimate results in those patients who recover from the operation statistics

See Internat Abstr Surg 7 Mar 7

show that 60 to 75 per cent are absolutely cured from 75 to 90 per cent are either absolutely cured or are so greatly benefited that they do not require further medical treatment

Obviously it is impossible to compare the ultimate results of medical treatment with surgical treatment for every conservative surgeon insists that every case of peptic ulcer shall have the advantage of good medical treatment before surgery is considered. Therefore, every well selected surgical case of gastric or duodenal ulcer represents a medical failure or more accurately stated repeated failures on the same patient. So if the medical man can cure 50 per cent of the cases of ulcer and we as surgeons can cure 85 per cent of his failures there seems to be no good reason for rivalry.

3. Concerning the *modus operandi* of the cure of gastric and duodenal ulcer most recent authorities seem to agree that the chief end to be desired is rest and the reduction of the acidity of the gastric juice. The most modern and apparently the most rational medical treatment (Sippy's) is based entirely upon temporarily neutralizing the acid gastric juice by the frequent administration of bland foods and alkalis combined with the removal of the excessive gastric juice during the hours when food is not taken thereby permitting the ulcer to heal. A certain percentage of ulcers thus treated medically apparently recur and repeatedly recur in a few weeks or months after the treatment has been discontinued. It is this class of cases that the surgeon is called upon to treat. His work is to neutralize the acidity of the gastric juice by a continuous and permanent automatic process.

There are two theories as to the way in which this reduction (30 per cent according to Paterson) of the acidity of the stomach contents is brought about (a) more rapid drainage by which the acid is drawn out of the stomach (b) a new opening which increases the flow of alkaline bile and pancreatic juice into the stomach.

There is a good deal of rivalry between the advocates of these two theories. Both in the interests of harmony and because it is probably true it seems wise to suggest that both theories are right, and that the reduction is brought about both by permitting a more rapid exit of the acid gastric juice and at the same time a more extensive inflow of alkaline bile and pancreatic juice.

4. The more radical operations such as excision of ulcer segmental excision of portions of the stomach for ulcer blocking of the pyloric end of the stomach by various methods have certainly given us a greater mortality than occurs

## OPERATIONS FOR CHRONIC GASTRIC AND DUODENAL ULCERS

TABLE I—SURGEONS

Type of Operation	N Cases	Deaths	Per Cent	Secondary Peptic Ulcer
Uncy — 100 (1015 (3) cases)				
Pyloroplasty (Pancy)	100	1	5	
Simple gastro-enterostomy	100	7	7	
Total	100		6	
von Eisberg 100 (1015 (4) years)				
Simple gastro-enterostomy	334	7	5	4
Gastro-enterostomy with anastomosis	36			
Excision of ulcer	34	9	6	3
Jejunostomy			1	
Pylorotomy 4 cases (mortality not stated)				
Total	450	38	8.5	7

TABLE II—HOSPITALS

	N Cases	Deaths	Per Cent
Massachusetts General			
0			
0	43		
0.3	54	7	
0.4	48		
Total	67		6
Gastro-enterostomy	50	9	6
Staff of Roosevelt H. pital (Reported by Charles H. Leck)			
January 1910 to June 1915 (5 years)			
Total	104		9.6
Gastro-enterostomy	87	8	

Total number of cases of chronic gastric and duodenal ulcer operated upon and included in the above report of von Eisberg 100 (Massachusetts General Hospital and Roosevelt H. pital) 450 deaths 70 (2.5 per cent). Total number of gastro-enterostomies 67 deaths 4 (6 per cent).

with simple gastro-enterostomy. There is no adequate proof in the sum total of the literature on the subject to indicate that the results are enough better to justify the increased danger. It is undoubtedly true that the great majority of conservative surgeons are returning to the belief that posterior gastro-enterostomy is the operation of choice and may possibly be the only operation which should be used in the treatment of gastric and duodenal ulcer except for very special indications.

5. The fifth conclusion we shall put in the form of a question and shall attempt to answer the question by a study of statistics. Is the operation of gastro-enterostomy so safe and are the after results of the operation so sure that the average surgeon and more particularly the occasional operator can conscientiously urge his patient to be operated upon for gastric or duodenal ulcer? What are the facts concerning the mortality and ultimate results of the surgical treatment of gastric and duodenal ulcer?

TABLE III—OPERATIONS FOR CHRONIC GASTRIC AND DUODENAL ULCER—AUTHOR'S CASES

No.	Sex	Date	Type of Operation	Result of Operation	Later Complications
1	M	1904 Apr 14	Posterior gastro-entrostomy	Recovered	
2	M	Aug	Posterior gastro-entrostomy	Recovered	
3	F	1905 May 30	Posterior gastro-entrostomy	Recovered	
4	F	June	Posterior gastro-entrostomy	Recovered	
5	F	July	Posterior gastro-entrostomy	Recovered	
6	F	Aug	Posterior gastro-entrostomy	Recovered	
7	F	1906 Feb 12	Posterior gastro-entrostomy	Recovered	
8	M	April 7	Posterior gastro-entrostomy	Recovered	
9	M	Dec 6	Posterior gastro-entrostomy	Recovered	
10	F	1907 Jan 8	Posterior gastro-entrostomy	Recovered	
11	M	Jan 30	Posterior gastro-entrostomy	Recovered	
12	M	Mar 4	Posterior gastro-entrostomy	Recovered	
13	M	April 4	Posterior gastro-entrostomy	Recovered	
14	M	May	Posterior gastro-entrostomy	Recovered	
15	M	July 8	Posterior gastro-entrostomy	Recovered	
16	M	July 7	Posterior gastro-entrostomy	Recovered	
17	F	Oct 5	Posterior gastro-entrostomy	Recovered	
18	F	Nov 8	Posterior gastro-entrostomy	Recovered	
19	M	Nov 8	Posterior gastro-entrostomy	Recovered	
20	M	Dec 6	Posterior gastro-entrostomy	Recovered	
21	F	1908 Jan 14	Posterior gastro-entrostomy	Recovered	
22	M	July	Posterior gastro-entrostomy	Recovered	
23	F	Aug	Posterior gastro-entrostomy	Recovered	
24	M	Oct	Posterior gastro-entrostomy	Recovered	
25	F	Oct	Posterior gastro-entrostomy	Recovered	
26	F	Nov 8	Posterior gastro-entrostomy	Recovered	
27	F	1909 Mar	Posterior gastro-entrostomy	Recovered	
28	M	July	Posterior gastro-entrostomy	Recovered	
29	M	July 30	Posterior gastro-entrostomy	Recovered	
30	F	Aug	Posterior gastro-entrostomy	Recovered	
31	F	Sep 3	Posterior gastro-entrostomy	Recovered	
32	F	Sep 10	Posterior gastro-entrostomy	Recovered	
33	M	Nov	Posterior gastro-entrostomy	Recovered	
34	M	Nov	Posterior gastro-entrostomy	Recovered	
35	M	1910 Jan 6	Posterior gastro-entrostomy	Recovered	
36	F	April	Posterior gastro-entrostomy	Recovered	
37	M	Apr 130	Posterior gastro-entrostomy	Recovered	
38	M	May 30	Posterior gastro-entrostomy	Recovered	
39	M	July	Posterior gastro-entrostomy	Recovered	
40	F	July 20	Posterior gastro-entrostomy	Recovered	
41	F	Oct 20	Posterior gastro-entrostomy	Recovered	
42	M	Oct 25	Posterior gastro-entrostomy	Recovered	
43	M	Nov 8	Posterior gastro-entrostomy	Recovered	
44	M	Nov 8	Posterior gastro-entrostomy	Recovered	
45	M	Nov 8	Posterior gastro-entrostomy	Recovered	
46	M	Dec	Posterior gastro-entrostomy	Recovered	
47	M	Dec	Posterior gastro-entrostomy	Recovered	
48	M	Dec	Posterior gastro-entrostomy	Recovered	
49	M	1911 Jan 6	Posterior gastro-entrostomy	Recovered	
50	F	Apr 14	Posterior gastro-entrostomy	Recovered	
51	M	Apr 14	Posterior gastro-entrostomy	Recovered	
52	M	May 17	Posterior gastro-entrostomy	Recovered	
53	M	May 17	Posterior gastro-entrostomy	Recovered	
54	M	Nov	Posterior gastro-entrostomy	Recovered	
55	M	Nov 14	Posterior gastro-entrostomy	Recovered	
56	M	1912 Mar	Posterior gastro-entrostomy	Recovered	
57	F	Mar	Posterior gastro-entrostomy	Recovered	
58	F	Apr 1	Posterior gastro-entrostomy	Recovered	
59	F	Apr 1	Posterior gastro-entrostomy	Recovered	
60	F	Apr 1	Posterior gastro-entrostomy	Recovered	
61	M	May 14	Posterior gastro-entrostomy	Recovered	
62	M	May 14	Posterior gastro-entrostomy	Recovered	
63	F	Dec	Posterior gastro-entrostomy	Recovered	
64	M	Dec	Posterior gastro-entrostomy	Recovered	

TABLE III—(continued)

TABLE III—(continued)

N		D	Type of Operation	Result of Operation	Later Complications
35	F	Jan	Partial gastrectomy	Recovered	None
36	M	Mar	Partial gastrectomy	Recovered	None
37	M	Apr	Partial gastrectomy	Recovered	None
38	M	Apr	Partial gastrectomy	Recovered	None
39	M	Apr	Partial gastrectomy	Recovered	None
40	M	Apr	Partial gastrectomy	Recovered	None
41	M	Apr	Partial gastrectomy	Recovered	None
42	M	Apr	Partial gastrectomy	Recovered	None
43	M	Apr	Partial gastrectomy	Recovered	None
44	M	Apr	Partial gastrectomy	Recovered	None
45	M	Apr	Partial gastrectomy	Recovered	None
46	M	Apr	Partial gastrectomy	Recovered	None
47	M	Apr	Partial gastrectomy	Recovered	None
48	M	Apr	Partial gastrectomy	Recovered	None
49	M	Apr	Partial gastrectomy	Recovered	None
50	M	Apr	Partial gastrectomy	Recovered	None

Unfortunately a curate fact is quite hard to obtain in the literature. The general impression has gone abroad that an operation is just certainly a cure for peptic ulcer and that the mortality is very low. As a result of this general surgeons who have had no special training in and have made no special study of the subject do not hesitate to recommend and perform surgical operations for ulcer of the stomach and duodenum whenever such cases present themselves for treatment. Furthermore every here in the country general practitioners doing only the surgery coming in their family practice are doing surgery for ulcer of the stomach and duodenum.

Outside of the Mayo Clinic which during the past few years has reported the smallest death rate in a large series of cases that has been reported, Finney seems to have obtained the best results in a series of consecutive cases extending over a period of ten years or more that have been reported.

I think it will be conceded that no surgeon in Continental Europe ranks higher in gastric surgery than von Eiselsberg of Vienna.

From the standpoint of the number of cases of gastric and duodenal ulcer operated upon and the good results obtained from the operation the reports of the Massachusetts General Hospital show better than any other hospital in America except the Mayo Clinic as far as the reports have come to me.

I think that no competent judge of hospitals could name the twelve best conducted hospitals (speaking from the standpoint of medical and surgical efficiency) without including the Roosevelt Hospital in New York City. Dr. Charles H. Peck, one of the most reliable surgeons in America, has recently reported the work in gastric and duodenal ulcer by the staff of Roosevelt Hospital from January 1, 1910 to June 1915 (5½ years).

As we have accurate reports from these four sources I begin to submit the results of the very best work that is done anywhere as shown in Tables I and II.

No, if the best hospital and among the very best surgeon of the world in the aggregate have a mortality of 5 per cent in the surgical treatment of gastric and duodenal ulcer and a mortality of 6 per cent following gastroenterostomy for ulcer, what are we to expect as to the actual mortality in the hands of the staff of the average and below the average hospital. It certainly would be much greater than the statistics I have just quoted. And above all what are the probable statistics in the hands of the occasional operator. It is safe to hazard the guess that most of us would prefer to keep our ulcers rather than to take the chance.

In my own practice I have probably done a larger proportion of radical operation such as excision of the ulcer, unilateral excision and other forms of pyloric blocking and pylorotomy than most operators. Therefore I begin to submit Table III which includes every case of chronic gastric and duodenal ulcer that has been operated upon by me in my regular operating hospital from April 14, 1904 to November 25, 1916. Cases 1 to 42 were operated upon in the North Pacific Sanatorium (private hospital). Cases 42 to 107 inclusive were operated upon in St. Vincent's Hospital. Cases 108 to 150 inclusive were operated upon in the Portland Surgical Hospital (private hospital). A few cases have been operated upon at miscellaneous hospitals of which we have no accurate record and which it would not be proper to report even if we had. The cases are given by years also the date upon which the patient entered the hospital is given the type of operation performed the immediate result of the operation and the known later complications.

TABLE IV—CASES OPERATED UPON FROM APRIL 14 1904 TO NOVEMBER 28 1916 (12 YEARS)

	No Cases	Died	Per Cent	Secondary Peptic Ulcer
Simple gastro-enterostomy	83	3		
Finney pyloroplasty	8			
Finney and Ballour (comb med)			00	
Ballour cauter				
Rodman pylorocotomy	th gastro enter			
ostomy	4	4		
on E. and berg each on — th gastro-entero			0	
stomy				
Simple etc. on of Boon leer	8		3	
Simple re-ect on				
Jejunostomy				
Total	90	8	9	4

Table IV gives a summary of the twelve years work including 150 cases

Table V gives a summary of the last six years work of the twelve including 107 cases

In one sense I am proud of this report. In another I am sad to think that had I been less radical several of my patients who died would have been alive. For I must confess that the four patients operated upon by the von Eiselsberg and Rodman methods who died were no more difficult and no worse operative risks than the 83 patients upon whom I did a simple gastro enterostomy without exclusion or resection. Assuming this to be the fact there would have been one fatality in these cases instead of four. Also had the 22 patients operated upon by the von Eiselsberg exclusion and gastro enterostomy been operated upon by simple gastro enterostomy the probabilities are that there would have been no secondary ulcer in either case.

The optimist may say that this is luck, were it not for the fact that all of these patients on whom resection or exclusion was done had a more stormy convalescence than those upon whom a simple gastro enterostomy was done.

The optimist might further state that possibly the ultimate results might be enough better to compensate for the increased mortality. Unfortunately this has not been the case for a general survey of the simple gastro enterostomy cases compared with the von Eiselsberg exclusion cases how nothing in favor of the von Eiselsberg operation in the ultimate results.

The optimist might further state that the fact of two secondary ulcers having developed after the operation might be purely accidental but why did 2 out of 36 of von Eiselsberg's patients on which the unilateral exclusion had been performed (a rate of 5 per cent) develop secondary ulcer while only a little more than 1 per cent of his simple gastro enterostomies developed secondary ulcer.

TABLE V—CASES OPERATED UPON FROM NOVEMBER 18 1910 TO NOVEMBER 28 1916 (6 YEARS)

	No Cases	Died	Per Cent	Secondary Peptic Ulcer
Simple gastro-enterostomy	43	0		
Finney pyloroplasty	7	0		
Ballour cauter				
Simple etc. on of callous ulcer	9			
Jejunostomy				
Simple resection	7	4	3	
on Finney and Ballour (comb med)			00	
on E. and berg each on with gast				
entero stomy			0	
Rodman pylorocotomy — with gastro enter				
ostomy	2	2	4	
Total	97	6	6	4

If there were advantages in the exclusion operation or the resection operation such an operation should be done in two stages. The gastro enterostomy first and in the course of two to four weeks, the exclusion or resection operation if necessary. As a rule however the patient is so well at this length of time that there seems no need for the second operation. In at least five out of the six such operations which I have done in two stages the ulcer had disappeared to such an extent that it seemed a shame to do any further operating and in one I actually closed up without doing the second operation.

As a result of a careful study of this subject together with a limited personal experience I believe the following will be my practice in the future.

All duodenal ulcers will be covered over by omentum and a posterior gastro enterostomy by the Mayo or Moynihan technique performed without artificial obstruction. Or in certain cases, it is convenient to excise an ulcer near the pylorus combined with a Finney pyloroplasty.

Gastric ulcers on the lesser curvature which are small and indurated will be treated by the Ballour cauter plus the Finney pyloroplasty or gastro enterostomy.

Large ulcers in other parts of the stomach will be treated by first doing a gastro enterostomy or a Finney pyloroplasty followed by Sippy's plan of medical treatment with a resection later if necessary.

Ulcers involving a very large area of the wall of the stomach may be given rest and the patient nourished by jejunostomy.

Ulcers near the pylorus having a suspicion of cancer will be treated by the Rodman operation done in two stages.

If this plan been carried out through all my work I have good reason to believe that my total mortality in the 12 years work would have been less than 5 percent instead of more than 5 percent.



# DEPARTMENT OF TECHNIQUE

## THE MODERN TREATMENT OF CLUB FOOT

By R. J. BEHAN, M.D., PH.D.

From St. Joseph Hospital

THE principal foot deformities—club foot, hollow foot, flat foot—are the result of misapplied force, paralysis of muscles and pathologic structural changes. Under the first comes trauma, bad fitting shoes, incorrect posture in standing and in walking. Under the second are classed the deformities arising as the result of infantile and birth palsies and spasmodics. Under the third are grouped those diseased processes causing a destruction of bone such as syphilis, tuberculosis, arthritis deformans, etc.

It is not my intention to enter into an exhaustive discussion of all foot deformities, but I shall restrict myself briefly to that termed club foot, namely the talipes equino deformity. To be properly equipped to form a judgment as to the means of relieving the distressing club foot deformities, I beg of you to pardon me while I briefly review the essentials in the etiology, some of the pathology and the treatment of this most protean of all foot imperfections.

Etiological factors may be divided into the prenatal and postnatal.

1. The *prenatal* which are the most important may be separated into (1) heredity in which is included maternal impressions, (2) deficiency of intra uterine space producing pressure on the developing feet, (3) nervous or musculoneurotic causes, (4) arrest of osseous development.

Of all these factors the first two which act in a mechanical manner are the most important. Indeed it seems that the majority of club feet are of this origin. The proportion of children born with club feet is about one in two thousand.

Club foot is frequently associated with other congenital defects such as spina bifida occulta. It was our custom in every case of club foot to examine for spina bifida. An indicative sign is a growth of hair over the lower lumbar spine.

2. *Postnatal causes*. The postnatal develop-

ment of true club foot, that is, the equinovarus form, is not so very rare and is the result of (1) paralysis of groups of muscles supplying the foot. This defect is usually the end result of an acute infantile paralysis, (2) Trauma. At times the force of trauma may be exerted on the foot in such a direction that club foot results, pressure of the bed clothes in debilitated states may produce drop foot (a mild form of talipes equinus).

3. Disease such as tuberculosis, rickets and syphilis is also potent in its activity to cause foot deformities.

A knowledge of the causation of the particular club foot under observation is of value in that the treatment varies according to whether the deformity is of paralytic, mechanical or pathological origin. The relations of these factors to the different methods of treatment are of importance and will be entered upon later. As a perfect understanding of a diseased condition depends upon a thorough knowledge of the anatomy and pathology of the condition it will be well for us to glance briefly first at the anatomy of the foot.

The foot consists of the os alia, astragalus, scaphoid, cuboid, external middle and internal cuneiform, the metatarsal bones and the phalanges.

To better understand the mechanics of club foot reduction a brief review of the articulations of the foot is necessary. These articulations are divided into the upper and the lower.

The upper is the ankle joint and is the so called *ober Sprunggelenk*, upper spring joint of the Germans, and the midtarsal joint or the lower spring joint of the Germans.

The lower *Sprunggelenk* consists of the articulations between the cuboid and scaphoid in front and the astragalus and os calcis behind. It permits of a limited degree of every variety of motion, i.e. flexion, abduction, adduction and rotation.

As a rule it is by the giving way of this latter joint that flat foot is produced. In club feet also the greatest changes are in this articulation.

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so that the midtarsal joint becomes of prime importance in the correction of foot deformity.

By a study of this joint it is easy to understand why a rotary movement is necessary to correct a club foot, for it is in the midtarsal joint that the forces are applied which produce club foot. Therefore the forces must be applied in the same joint to correct the deformed foot. These forces, however, must be in a direction exactly opposite to the causative forces and act through an arch corresponding to the path which the club foot followed in its course of development. It is also apparent that, since all the bones of the foot are so closely united, movement of one bone will cause movement of all of them, so that the rotation of the foot will have a tendency to correct and force all the bones, especially the os calcis into their proper places. After once being forced into place, fixation by the means at hand will tend to mold the bones into coaptive relationship.

As the pathology of club foot is extensive, I shall not discuss it. Any one who is interested may find all he desires in any good textbook on orthopedic surgery. It will suffice for us to remember that the anterior part of the foot is turned inward, the os calcis is directed backward and in cases of great severity the inner border of the foot is turned almost exactly upward. The bones are deformed in consequence of misdirected angulations of force; the ligaments are either elongated or contracted and it is these ligaments that are the greatest hindrance to reduction. Therefore the first stage of any treatment should be the softening or relaxation of the contracted ligaments. The next stage is the bringing of the foot into a better position. The last stage is fixation.

The first of these processes is best produced by hyperæmia, the second by manual force for infants and children under three years of age, or by the vacuum apparatus or the forcible or operative correction in adults. Fixation is best induced by the spring bandage in infants and by plaster in adults.

In every case the earlier the treatment the better the results. This applies particularly to the congenital variety found in children. The child increases more in length the first year than it does at a later period in three or four years (Camerer). Should the limb be deformed, this disproportionate increase in growth greatly and disproportionately increases the deformity. On the contrary, if the deformity is corrected the rapidity of the growth is in and both to the healing and to the proper molding of the foot. It should be remembered that the weight of a new

born begins to increase from the tenth day on while the length of the body begins to increase only after the third week. It is best therefore to begin corrective fixation methods only after three weeks. In every case correction should be attempted as early as possible after three weeks for the longer the deformity persists the greater will be the muscular contractions and the more difficult will be the ensuing corrections.

The technique of correction in infants is as follows: (1) the softening and relaxation of the tissues; (2) the correction; (3) the fixation.

1. It has always been the aim of various operators to find a means of softening the soft parts and relaxing the tendons. Hyperæmia as a rule has been the softening medium. It was first produced by the rubbing in of fats, oils, etc. as in the method of Bell, Hildanus, etc. This was prior to the days of antiseptics. As soon as operative interferences became safer, this method (technique) fell into disuse and was forgotten and the pendulum swung to operations. However, the idea of using hyperæmia as an aid to reduction we find cropping up every now and again and it was owing to the suggestion of Stromejer that Frankel began to use hot air as a means of inducing hyperæmia. According to his technique the infant's foot is placed in the hot air box for one half hour or until the tissues become quite lax. (If the hot air apparatus is not at hand, hot compresses, etc. may be used.)

2. After the tissues have become properly softened the next procedure is the correction. In small infants this may be done by hand. In older patients mechanical aids are necessary. For a proper correction it is necessary to turn the foot first into dorsal flexion and the best method of bringing this about is to grasp the foot with the opposite hand to that of the foot involved. The thumb should be placed on the dorsal surface over the metatarsi and the fingers should lie flat against the plantar surface. Flexion and external rotation are produced by alternating periods of force and relaxation. This hand correction is very tiresome. The next effort is, second, to swing the foot into pronation and external rotation. To lessen this part of the toil Dr. Frankel devised a spring and adhesive plaster bandage. This was primarily used for very young infants to fix the foot after its hot air bath and correction. However, it acts very nicely as a corrective medium for those who are somewhat older. The spring consists of a longitudinal spiral (Fig 1). It exerts pressure on two strips of adhesive plaster. The first is over the malleoli and has a tendency to roll the foot inward, one end of the

spring is attached to it. The second plaster bandage is placed around the base of the foot and the metatarsi and is then carried up along the outer side of the leg to above the knee where it is held fast by a circular bandage. The other end of the flanged spring is attached to the inner side of this strip at the base of the external malleolus. In order that the spring may have sufficient play, neither one of the two plaster strips should be applied too tight. Over the outer malleolus a felt protector is placed. It is important that the spring should not be too strong (Fig. 2).

The spring remains in place two or three days, then is removed and a hot air bath is given. The spring is then again reapplied and again changed in two or three days. This is continued until an overcorrection is obtained and then a plaster bandage is applied.

The foot must remain in this plaster support until the bones have been molded. Some surgeons use a plant for this purpose but it seems that plaster because of its simplicity and rigidity is the best for ambulatory treatment. As the plaster is hardening the same rotary correction is given to the foot as when it was being corrected. While making this correction opposing rotation is made on the knee. If we are in small infants because of the difficulty of application and retention the plaster cast is mottled and the spring bandage cast at the same time both as a correcting and a fixing apparatus. In putting a cast on the feet of young children, only a very thin layer almost veil like in thickness of cotton wadding should be applied and this, owing to the peculiar onical shape of the infant's foot and leg, the cast has a constant tendency to slip off.

The total time of treatment corresponding to the age of the child and the extent of the deformity is from three to nine months; the cast is renewed at intervals of four to six weeks. The traction directs the planes of growth and allows the pronating muscles to become shorter.

To guard against a recurrence over correction is absolutely necessary.

Opponents of the plaster treatment claim in favor of splints that the ensuing atrophy is less than with plaster. However if there is atrophy from the use of plaster it quickly disappears on the renewal of function of the muscles. Other objections are without foundation.

In older patients manual correction is a little more difficult and other means must be considered. These are grouped under (1) operative interference such as tendon or bone plasticity, (2) forcible correction either by hand or by

mechanical aids, (3) hyperæmia and suction correction after the method of Frankel.

1. *Operative methods* are tenotomy, fascial and muscle sectioning and bone operations.

*Tenotomy.* At the present time tenotomies are favorite procedures in the corrective treatment of club feet especially popular is achillotomy. Opponents of Achilles tendon and plantar section however are not lacking. Among those to be mentioned are Barkwell, Hueter, Kocher and Ruysschicht. The latter was particularly shocked by the poor results of such treatment. Even the strongest advocates of tenotomy such as Stromeyer believe that of itself it had no value unless it is followed by the most careful orthopedic after treatment.

The idea that plantar tenotomies were absolute essentials in the treatment of club foot probably arose from the fact that many orthopedic surgeons held that club feet were of paralytic origin and that tenotomy was of value in slanting the contracted muscle off the axis of the foot out of activity so that paralysis was then made complete and the possibility of healing in the corrected position was increased. However in many of these cases after the adduction has been corrected it was found that further progress was rendered difficult by the false position of the os calcis due to the contraction and unopposed action of the Achilles tendon and it required sectioning which as we shall see later renders club foot reduction more difficult. In other and perhaps as numerous cases the lax flaccid tendon is found inserted into an antrophied calcaneal process. To section such a tendon would be absolutely of no value. Nevertheless the assertion is made that in some cases tenotomy renders club foot reduction much easier.

If one examines into complements entering into the correction of a club foot it is found that all club feet of whatever variety must in the evolutionary process of correction pass through the stage of the so called spitz foot or pointed foot or pes equinus.

Should the Achilles tendon be sectioned the accomplishment of this maneuver is rendered almost impossible. This is the experience of Lorenz who practiced tenotomy of the Achilles. He found that the correction of the spitz or supinated foot is the most difficult. This is due to the lack of a firm fixed base which acts as a fulcrum for the further corrective processes. With the Achilles tendon intact the os calcis will act as such a fulcrum. With a mobile os calcis as after tenotomy we have no such fulcrum.

Even if the tibialis anticus and posticus the

plantar muscles or gastrocnemius are shortened as a result of the deformity it is problematical if section of the Achilles tendon will be sufficient to correct the deformity. In such cases as a rule it is necessary to perform a tendon implantation. In no case does tenotomy seem to be absolutely necessary and it should be avoided for it is in patients who have had a tenotomy that recurrences are the most common.

For the reasons just enumerated it is evident that tenotomy as the initial process in club foot correction except in the paralytic form should be discarded. The most it can do is to produce a hollow foot or pes cavus and render more difficult the correction. As a terminal act the tenotomy may have some value in restoring disturbed muscular equilibrium.

**Muscle and fascial sectioning.** We will not exhaustively consider muscle or fascial sectioning as the soft tissue contractions disappear very quickly under hyperemia. Sectioning of the muscles as recommended by Diefenbach a founder of German surgery and also by Stromeyer the first of the plastic orthopedists has long been relegated into the disuse which it deserves. The more radical operation of Phelps in which the plantar fascia (ligamentum deltoideum) is sectioned and even the astragulo-scapoid joint is opened should never be considered. The still more radical method of Codovilla we will not even consider.

However in certain forms of club foot surgical interference is indicated namely in those cases in which muscular paralysis is present or in which there is an overstretching of the muscles. In these conditions it is sometimes necessary to implant the Achilles tendon into the outer margin of the os calcis or to make a periosteal implantation of the tendon of the tibialis anticus into the outer margin of the foot.

**Bone plastics.** Of the operations on the bone the two best are (1) the extirpation of the astragalus—talus—Lunds Ogston (2) the resection of the cuneiform (Davies Colley).

Both of these operations are valueless of themselves unless combined with other methods of treatment. However in some cases they are useful.

The operative method the favorite until the introduction of anesthesia opened the way to the next period of progress in the treatment. It was the bloodless forcible correction. Surgeons of large experience like Codovilla and Graser have been strong advocates of this method.

The forcible method produces a sudden correction of the club foot with much force and re-

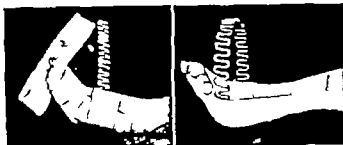


Fig. 1 (at left) A is the adhesive which goes around the ankle at the level of the malleoli. The malleoli are protected by pads. C is the pad over the external malleolus. The adhesive B is reflected back and the free extremity is brought up on the outside of the limb as shown in Fig. 2.

Fig. 2. Shows the wire spring in place and the circular bandage around the leg below the same.

quires great strength or a proper instrument. There is always associated a considerable degree of tissue destruction and pain which persists for several days. For this reason it is necessary that the plaster cast which is applied immediately after correction be split lengthwise—or many windows be cut in it—(Lorenz). Associated with forcible correction are wide and deep tears in the skin subcutaneous tissue fascia and muscle—in some instances the tears are 5 to 6 centimeters (2 to 2½ inches long). There is also danger from the contraction of the scar resulting from the fascial tears. As an indication as to how great the tearing may be it is only necessary to remember that many operators have found it necessary to devise a pediculated flap for covering the denuded area.

It would be well if the tearing etc. due to forcible correction were limited to the soft parts alone but unfortunately as both Kocher and Koenig emphasize the periosteum cartilage and even the bone may be injured in this forcible method of treatment.

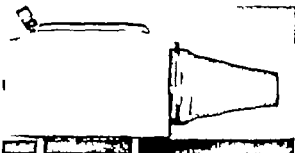
As the degree of force necessary to correct a club-foot in the adult is possessed by but few men mechanical helps were devised namely

1. Koenig's wedge
2. Turner's lever
3. Combination of above two
4. Lorenz's redresseur (first of its kind)
5. Adjustable pelotten of Schultz and Graff

These apparatuses are for the correction of adduction and the equinus.

The disadvantages of forcible correction are numerous and include

1. Contractions. In many instances contractions follow both the operative and the forcible correction of a club foot. These contractions render ineffective the beneficial effects which



For the first time, the patient has been able to walk without pain. The treatment has been successful in all cases. The patient has been able to walk without pain. The treatment has been successful in all cases.

The result is a perfect anatomical correction.

Recurrent. The scar tissue is of the most intense character. I cannot find the recurrence. The scar tissue is of the most intense character. I cannot find the recurrence.

Complete result. The result is a perfect anatomical correction. The result is a perfect anatomical correction. The result is a perfect anatomical correction.

4. Unilateral result. The unilateral result is a perfect anatomical correction. The unilateral result is a perfect anatomical correction. The unilateral result is a perfect anatomical correction.

5. Injury (supramalleolar) of tibia. The injury is a perfect anatomical correction. The injury is a perfect anatomical correction. The injury is a perfect anatomical correction.

6. Fat emboli. Pavy mentions fat emboli as being common in the forcible correction of club foot. They are especially dangerous in those cases of paralytic ositi, the result of paralytic lesions. They are sometimes extremely easy to produce for out of the compressed osseous tissue without even undue force. Fluid fat is pressed from the position into the general circulation. Old accidents are fairly frequent, such as tuberculous of the foot which finally has led to amputation (Ellen). Disturbances of the eye sight due to fat emboli in a double congenital club foot (Lange) and a death from fat embolus occurred in Hochenegg's clinic.



The patient has been able to walk without pain. The treatment has been successful in all cases. The patient has been able to walk without pain. The treatment has been successful in all cases.

A careful perusal of the literature will apprise us of the fact that death has occurred from a treatment of forcible correction.

11 stages of forcible reduction. The value of forcible reduction lies in the rapidity of the correction. However, we have performed further and further from the possibility of total correction in a single sitting, and to this forcible correction is carried out in different stages. If this is done, the treatment is divided into stages. That this is not at all uncommon may be proved from the records of Lange who says: "I have accepted for treatment children who have been anesthetized many times, 10, 15, or 24 consecutive times and in spite of this the result is usually a not pronounced."

To obviate the marked disadvantages of forcible correction Frankel of Berlin devised his traction apparatus which exerts a constant force tending to flex and at the same time rotate the foot (see Fig. 3).

The apparatus consists of a table from which all the weight is taken. The apparatus is so arranged that the patient lies on the foot. The patient is so arranged that the patient lies on the foot. The patient is so arranged that the patient lies on the foot.

the air is exhausted and the correction goes on automatically. The air is exhausted either by a water or electrical vacuum pump. The amount of pressure is controlled by the degree of vacuum and this in turn is shown by the vacuum meter which is attached. However, before the foot is placed in this correcting apparatus it is subjected to a hot air bath for 20 minutes.

The action of the negative pressure in the apparatus to produce hyperemia. If the hyperemia is active enough it may cause even a change in form of the tarsal bones. This has been proved experimentally by G. Sangorski who produced softening of the bone by severe hyperemia. In using the suction apparatus it is necessary in order not to produce excessive degrees of hyperemia to interrupt at times. The application is entirely painless. This may be due to the moderate degree of oedema which will according to observers in Bier's clinic produce an infiltration of the nerve and thus reduce pain sensation. This method of application is contrary to the practice of Codovilla who advises the use of a hyperemia bandage until oedema of the part results.

A description of the method from which the greatest results may be obtained and with which I have had personal experience follows: (1) Place the foot in a hot air bath 20 minutes. (2) correct in the suction apparatus 20 minutes. (3) apply hot air.

One of the principal actions of the latter is to rid the foot of the oedema which has accumulated during the action of the suction apparatus. This oedema would interfere with the application of the fixation bandages. Should a slight oedema persist it is not disadvantageous in that it protects the foot from pressure, etc.

Fixation after the correction. It is necessary that the foot be retained in the corrected position by plaster of Paris. In no case has a bad effect or ulcer or necrosis been observed to follow as the result of the application of a plaster cast. The above technique applies to feet of sufficient

size and form to permit of the above manipulation. It is not suitable for infants' feet.

In every case there is more or less after treatment. The principal object of the after treatment is to bring the muscles into a state of equilibrium. It has been shown that even as overstretching of a muscle will produce functional disturbances. Stretching of a paralyzed muscle will cause it to resume its normal functions; therefore it is always advisable before doing a tendon transplant to see what effect stretching will have. If after a club foot correction the pronators do not contract rapidly enough the process must be hastened by physical means (hot air, massage, electricity) and functional measures. The mobilization of the foot should be continued as long as the peronei remain inactive and the foot tends to resume its former position. In the free periods the foot should not be left to itself but should be placed in a removable splint.

In regard to apparatus for holding the corrected foot in place, the best is probably the Hessian apparatus. A good appliance for the after treatment of club foot in the adult is that devised by Frankel. It consists of a laced leather legging and a foot brace. This is joined on the inner side by a steel brace with a hinge joint at the ankle. The upper portion of the outer brace is connected to the outer side of the foot brace by a heavy rubber band which keeps the foot in a pronated position.

With infants a splint for after treatment is not necessary; however, for the period between the circular bandage and the ambulatory period a simple internal splint of binder board is sufficient.





Fig 3 Lateral view. Arrows indicate old fracture lines. Figures indicate outline of air distended ventricle: 1 anterior cornu 2 posterior cornu 3 middle cornu 4 body of central horn.



Fig 4 Lateral view after operation. All air has disappeared. Ventricles not visible. Arrows indicate fracture line. X is the trephine opening through which trocar was inserted.

October 5 *physical examination*. White adult male conscious rational. Eyes pupils slightly unequal R>L both react promptly and properly to light and accommodation no nystagmus. An irregularity can be felt in frontal bone near median line. Tongue slightly coated protrudes straight no tremor pulse regular slow fair size force and tense. Abdomen negative extremities negative. Achilles cremasteric and abdominal reflexes active and equal on both sides no objective sensory disturbance.

November 5 *neurologic examination*. Patient's gait and station normal pupils unequal right slightly larger than left both moderately dilated both react slowly to light the left eye feeble reaction in convergence is feeble corneal reflex normal ocular motility normal eye grounds beginning postneuritic atrophy right side left moderate papillary edema slight right facial paresis tongue normal upper extremities normal lower extremities show muscular poverty and resistance good except slight weakness in posterior thigh groups knee jerks equal ++ no ankle clonus slight Babinski left (D. Leninsky).

*Operation*. November 8 1915. A right side subtemporal trephining, as done a small button was removed through which opening the right lateral ventricle was tapped with a trocar and cannula (Ochsner gall bladder type). The attached rubber tube had previously been completely filled with sterile water and the distal end was submerged in a test tube of sterile water.

When the trocar was withdrawn many large bubbles of air escaped through cannula and rubber tube and were demonstrated rising through the test tube of water. To our very great surprise this air was apparently not under pressure as it was in Case 1 and as we certainly expected it to be in this case. When the cannula was withdrawn it was followed by three spurts of air and fluid through the picture hole in dura. The wound was closed without drainage. Recovery from operation was uneventful but slow.

November 10 blood pressure 100/80. Ophthalmoscopic examination right disc—upper and lower and temporal margins blurred otherwise fundi normal. Drusen optic nerve mild type. Left disc—normal

and periphery. Right disc—edematous since last examination.

November 17 *neurological examination*. Condition unchanged eye grounds unchanged except decided hyperemia. He seems unreliable in his statements inattentive and forgetful. Ophthalmoscopic examination November 17 fundi normal right and left. No pathological condition.

November 18 out of bed on trial. November 17 discharged cured.

It is a standing order on my service that all suspicious head injuries with signs of pressure be lumbar tapped so it was carried out by one of the staff without our knowledge on this patient the day preceding the trephining when 5 cubic centimeters of clear colorless spinal fluid was withdrawn not under particular pressure. There were no cells no bacteria in the spinal fluid. Benedict positive. Noguchi negative.

This tapping probably accounts for our failure to find the air in the ventricles under great pressure as in Case 1.

Figure 4 taken November 4 after the operation shows no air. The round shadow marked X is the trephine opening. A plate taken a few days after the operation showed some slight traces of air remaining in the ventricles and as there is none in Figure 4 we can say that air can probably be absorbed in the ventricles. It is questionable if we withdrew all the air at the operation on the other hand the patient may have again forced air into the ventricles after the operation.

As a matter of routine our head injuries have insufflated into the nares pure boric acid powder. In by far the majority of cases it is non-irritating. Once in a while it causes sneezing. It did so in this case after the operation and was discontinued.

Recently seven months after the operation the patient except for an occasional slight dizziness was in good condition.





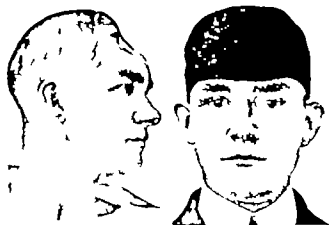


Fig. 2. Photograph of patient entirely recovered.

Fig. 3. Photograph of patient wearing black silk skull cap.

pieces of frontal bone missing measures 8 centimeters by 10 centimeters as shown in Fig. 1.

Figure 2 shows the patient entirely recovered. The scar on the right side is not quite smooth because the edge of the frontal on this side was so sharp that it had a tendency to cut through but is now absolutely smooth. Patient also has some acne which he has had for years. I was told.

Figure 3 shows the patient with a skull cap made by Treman of New York. It is made of black silk and a piece of aluminum is fastened inside just above the level of bony substance and acts as protection.

Figure 4 is the roentgenogram which I made before he left the hospital.

Following is the mental status of the patient taken by Doctor Theodore Irving Townsend, First Assistant Physician Binghamton State Hospital.

The chief characteristics appear to be a marked interference with lack of spontaneity, defective memory for the period following the accident but with excellent memory for the remote past, defective calculation, judgment poor and insight absent. No delusions, illusions or hallucinations. Orientation for time, place and person correct.

I had in mind to plate the loss of substance, but thus I found would require too large a plate.



Fig. 4. Roentgenogram of patient before he left the hospital.

I want to thank Harvey Cushing of Boston whom I consulted upon this particular step and who advised me not to do it.

My best thanks also to my friend T. I. Townsend who was kind enough to help me in the mental part of the case and who wrote the resume of his long and tedious study.

Thanks also to Drs. Gillespie, Chapman and Tiffany, all members of the staff of the Binghamton State Hospital who visited the patient at my request and helped me with their counsel.

NOTE:—On August 27, about two months after the completion of above article, the patient came to my office. Judging from his conversation, which is perfectly intelligent and normal, and his appearance, he has made a complete recovery, mentally and physically. He remembers every incident preceding the accident and described same and converses intelligently on current topics. His wife says he is the same as before the accident. He has been offered a position with the railroad company, having been pronounced competent by the railroad company's surgeon.

# THE TELEPHONE AS USED FOR THE LOCALIZATION AND REMOVAL OF METALLIC FOREIGN BODIES IN THE TISSUES

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THE localization for removal of small foreign bodies embedded in the tissues or lying in the potential body cavities may at times be a most difficult surgical undertaking. For such cases the radiographer devised the various triangulation and stereoscopic radiographs and Alexander Graham Bell introduced the induction balance and the telephone probe. The latter which is usually but undeservedly known as the Girdler probe has not received the attention it deserves. It is the object of this paper to call attention to its value and to describe its use.

The detailed electrophysics of the telephone need not here be described. Briefly it consists of a permanent electromagnet which on the passage of an electric current attracts or repels a flat iron disc the vibration of which emits the familiar sounds audible in the telephone receiver. If properly constructed it may be made an ex-

ceedingly sensitive instrument capable of detecting the most minute changes in the passage of an electric current. As used for the detection of metallic foreign bodies in the tissues this instrument is connected in circuit with a simple voltaic battery made up of the body fluid as the electrolyte and the probe or other exploring instrument as the electrode. The second electrode may be of various forms and substances and placed in various locations. Bell originally used a polished steel plate six by six inches and placed it after moistening with vinegar for better contact upon the back of the patient. Many other forms of this electrode have been described. Until recently it has been supposed that the two poles of the battery must of necessity be of the same metal. Accordingly when a silver probe was used a silver plate was necessary with a steel needle a steel plate and so on through all the possible metals. David on an experimentation found

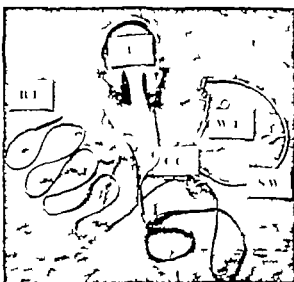


Fig. 1. Telephone that arises above a manual construction. Leader from receiver is connected to single lead until they are separated before termination. Connectors (C). From one of these lead to carbon rod electrode (R.F.). The other is attached to sterile insulated lead to the B. sound electrode. The lead is connected to a suitable instrument.



Fig. 2. Diagram illustrating the use of the telephone in the localization of needle fragments. A. Right hand. B. Left hand. C. Needle. D. Needle. E. Needle. F. Needle. G. Needle. H. Needle. I. Needle. J. Needle.

that the difference in potential between any metallic searching instrument and carbon was greater than that between two like metals. He accordingly used a specially constructed carbon plate placed upon the patient's back. The writer experimenting on animals by this method and using Davidson's technique found that the sounds in the telephone were none too audible due to the high skin resistance. Accordingly the electrode was changed in form from a carbon plate to a carbon pencil and in position from the patient's back to the rectum or in cases under local anesthesia, to the mouth. In this way an electrode suitable for use with a searcher of any metal was obtained and the high skin resistance was exchanged for the relatively low resistance of a moist mucous membrane.

It may be well before describing the clinical use of the instrument to explain its theory. The production of current is due to the difference in electric potential between the carbon and the examining metallic instrument. The best explanation of the varying sounds as heard in the telephone is that given by Canti<sup>1</sup> from whom we take the liberty of freely quoting. For purposes of description we will use the following characters:

Let  $r$  equal the resistance of the body tissues, the telephone receiver, all connecting wires, and the area of contact of the carbon pencil with mucous membrane. This resistance is at any time during use so nearly a constant that we will consider it to be so.

Let  $r'$  equal the resistance of the area of contact between the examining instrument and the body tissues. This resistance will be variable. If a fine needle be used for exploration and not deeply inserted into the tissues (good retraction or insulation) it will offer more resistance than a large probe deeply inserted. As will presently be developed it is advisable to keep the resistance of  $r'$  as high as possible.

Let  $r^2$  equal the resistance of the area of contact of the metallic foreign body sought with the tissues. This resistance will vary inversely with the size and consequently with the surface area of the foreign body and is therefore roughly proportional to its size. The larger the foreign body the less will be its resistance.

The intensity of the sound heard in a telephone receiver is within the limits for which it is designed proportional to the strength of the current at the time of its make and break. This current is equal to the electro-motive force divided by the resistance of the circuit or  $C = \frac{E}{R}$ .

At the moment of impact of examining instrument with the tissues the voltaic battery is established and the circuit being completed a current passes through the telephone. Depending on the intensity of the electro-motive force and

the construction of the instrument a click of varying intensity will be heard in the receiver but instantly the flow of current becomes even and the sound ceases because the diaphragm of the telephone is again stationary. The current which caused the sound and is now flowing is represented by  $C = \frac{E}{r+r'}$ .

The diaphragm while this current is flowing is slightly drawn in toward the magnets so that if the examining instrument be withdrawn and the contact broken the diaphragm will return to its original position and a click will again be heard in the receiver. If however the examining instrument be pushed farther and farther into the wound better and better contact will be obtained less resistance will be offered to the passage of the current and the value of  $r'$  will decrease. Although the flow of current through the telephone is thus increased no further click will be heard because the metal diaphragm is drawn slowly and evenly toward the magnet.

But at the moment of impact of examining instrument and foreign body there is a sudden and relatively great reduction of resistance with a consequent sudden increase in the flow of current and a sudden attraction of diaphragm to magnets resulting in a distinct telephonic click. The current now flowing may be represented as follows:

$$C = \frac{E}{r + \frac{r'r^2}{r+r^2}}$$

On breaking contact with the metallic foreign body another click will be heard due to the sudden increased resistance offered and the return of the metal discs to their original position.

If we substitute in the foregoing equations definite numerical values the explanation becomes more clear. Arbitrarily we will let our numerals have the following values:

Let $E$	equal	1000
$r$	equal	40
$r'$	equal	30
$r^2$	equal	20

Then at the moment of impact of instrument and tissues  $C = \frac{E}{r+r'} = 14 +$

And at the moment of impact of instrument and foreign body  $C = \frac{E}{r + \frac{r'r^2}{r+r^2}} = 19 +$

When two resistances are in parallel the total resistance is equal to the product divided by the sum.

There is thus a sudden increase in current represented by the difference in these two solutions namely  $4 +$

If the surface area of the foreign body be four times as large its resistance roughly will be one quarter as great i. e.  $r^2$  will only equal 5 instead of 20 (our original valuation). The equation will

$$\text{then read } C = \frac{E}{\frac{r}{r+r^2}} = 22 +$$

There will thus be a sudden increase in current represented by the figure  $8 +$  instead of  $4 +$  with a resulting louder click in the receiver

It is advisable to maintain as small a contact (or as high a resistance) as possible between the examining instrument and the body tissues. If this resistance is diminished by increased contact as with an uninsulated probe deeply inserted the change in current at the moment of impact with foreign body is not as great as would be the case with an instrument insulated except at its tip. Thus let the resistance of  $r$  be decreased from 30 to 10. Then solving the equation

$$C = \frac{E}{r+r} \quad (\text{contact of instrument and tissue})$$

we find that  $C$  equals 20 and solving the equation

$$C = \frac{E}{r + \frac{r^2}{r+r^2}} \quad (\text{contact of instrument and foreign body})$$

we find that  $C$  equals  $21 +$ . In other words instead of getting an abrupt change of current represented by the figure  $4 +$  we get a change amounting to only  $1 +$ . The truth of this theory is shown in practice for more distinct sounds are obtained with an insulated than with an uninsulated examining instrument

For clinical purposes the instrument is constructed and used in the following manner. The telephone which has proved most satisfactory is one having a combined resistance in the two ear pieces of about 1200 ohms. We have tried ear pieces from 75 to 3000 ohms combined resistance but have obtained the best results with a 1200-ohm instrument. The addition of dry cells of various voltage in circuit with magnets of different resistance has also been tried but has been discarded as unnecessary and oftentimes confusing, too loud a click being obtained on tissue contact. A double receiver is best used as it helps to exclude other and annoying sounds and the two ear pieces are connected with the usual metal band over the top of the operator's head. As the commercial headpiece is not entirely satisfactory in its construction we have had a special one made which has proved more stable and com-

fortable. By means of a long flexible silk copper wire insulated into the end of which has been soldered a hard carbon pencil  $\frac{3}{16}$  inches in length the circuit is led to either rectum or mouth. We have been in the habit of using the latter with local anaesthesia and the former with general. The circuit is completed by an insulated wire (pure rubber to withstand boiling) which leads to the operative field and is provided at both ends with connectors by means of which the current may be readily made or broken. The general construction and the arrangement of wires is shown in the accompanying figure.

The operative instruments themselves may be as varied as the fancy of the operator. All must be provided with suitable connecting rods. Personally we use only the few herewith shown and rely almost wholly upon ordinary sewing needles mounted by their blunt or sharp ends in suitable connectors. They are best insulated by roughening with fine emery and then dipping in the best quality of rubber cement or in a thinned shellac. If the latter is used sterilization must not be either by heat or alcohol.

As most of the work has been done with needles in the hand the technique for such cases will be described. It can be readily modified to apply to any suitable case.

The receivers are first comfortably fitted in such a way that contact with the head is good and extraneous noise is partially excluded. A reasonably quiet room must be insisted upon and talking prohibited. The non-sterile wires leading from the receivers to which the rectal and operative electrodes are to be attached are adjusted to lead down the operator's back and their ends fixed over the right hip with a safety pin. While the operator sterilizes his hands an assistant places the carbon pencil either in the anal canal or in the inside of the patient's cheek. With a little care in technique these pencils can be made without difficulty and a fresh one accordingly supplied for each patient. At the operating table all connections except with the operative instruments are made by a non-sterile assistant. The instruments and insulated wire to lead to the operative field will have already been boiled. In the case of a needle in the hand it is preferable to work with a tourniquet as it has been found that the value of  $r$  is higher in a dry than in a bloody field. At a suitable site as shown by the X, a half inch incision is made through the skin and the region supposed to contain the foreign body is punctured in many places. Using a fine needle it is perfectly safe to blindly puncture without fear of injuring tendon, nerve or blood vessel. In

this way every region of the hand has been explored without as yet a mishap of any kind and we now feel that far less damage is done by this method than by the usual large incisions. In cases already infected at the time of introduction of the foreign body or by previous attempts at removal care must of course be taken and deep puncturing avoided. Immediately on contact with the foreign body a distinct click is heard and on slight motion a grating sound is elicited. Neither of these is under any circumstances ever heard except on contact with metal. Having thus located the object sought one of a number of methods may be used for its removal. The exploring needle may be withdrawn and replaced by a fine mosquito forceps (in circuit) and using these as a probe the needle may be again found grasped, and removed. Or a fine scalpel or scissors may be used in circuit to enlarge the tract to the foreign body when it can be extracted by sight without the further aid of the telephone. Sometimes it is of service to connect in the same circuit two instruments. Thus an exploring needle can be used to locate the body left in place and a mosquito forceps passed along it as a guide until the needle is grasped.

Both instruments being in the same circuit no sound will be produced when they come in contact. Using this technique with its various modifications we have not to date lost or broken a needle in our series, and our average operating time has been less than ten minutes. Nor has it been necessary to make an incision over one inch in length.

The instrument is not meant to replace the X-ray and should not be used without its assistance when this can be obtained. The current produced is small and the sounds heard are not loud and are at times confusing. It responds only to metallic foreign bodies and bone and tense fibrous bands produce no sound. To one familiar with its use it becomes a most valuable aid in a surgical undertaking which seems simple to the patient but which may prove to be difficult or even impossible for the surgeon.

We desire to express our appreciation to Mr. Shirley, lately an employee of Bellevue Hospital for valuable suggestions and assistance in the technical work, and to the Experimental Laboratories of the New York Telephone Company for the very generous loan of instruments with which to carry on the experimental part of this work.

## RECTAL ANESTHESIA BY MEANS OF ETHER

WITH REPORT OF CASES

B. DR. J. B. MONTANA, FLORIZ M. L. C. A. M. I. A. S. A.  
 M. B. M. I. P. K. P. I. A. S. A. U.

**B**EING personally desirous of knowing the efficacy and innocuity of rectal ether anesthesia indicated by Dr. J. J. C. (with my of New York. I have tried this method in 17 cases operated on in my service in the Hospital of San Juan de Dios. The result is as follows:

**CASE 1.** M. N. P. (man) single age 30 (Colombian) white as operated on on October 8, 1904, for an enormous sarcoma of the right upper maxillary bone. On the day of operation, testinal lavage, 1 liter of tepid water was given some hours before the operation. The ether enema and as well as injection of 5 grains of morphine and 0.004 grains of rosyne given. The enema consisted of 60 grains of the and 4 of oil of olive and cold followed by hot. The patient was sufficient in minutes. The rectum of the maxillary bone as done in 4 minutes. There was no operation on the abdomen as normal and the patient left hospital in good condition.

**CASE 2.** M. P. (man) age 30 (Colombian) half-breed. Abdominal exploratory operation for ovarian cancer of the left ovary. November 9, 1904. An enema of 30 grains of castor oil as well as 1 grain of rosyne, 4 hours before operation. Hypodermic injection of morphine and rosyne 30 minutes before the abdominal enema of 30 grains of ether and 4 of oil of olive. No hit nausea and a little etherous gas per rectum. The product of ether per rectum was 60 grains in 10 minutes after. The operation as performed under calm and complete anesthesia. Sleep was prolonged several hours after operation. Later the patient vomited blackish fluid containing altered blood. Consciousness as normal and the patient left the hospital well.

**CASE 3.** P. M. (man) age 30 (Colombian) hit. Amputation of thigh in the lower third. November 8, 1904, for traumatic gangrene of the lower leg with blooded railroad injury. The interns forgot to give him a purge the evening before. Intestinal lavage 4 hours before operation. Hypodermic injection of morphine and rosyne some hours before rectal enema of 20 grains of ether and 40 grains of oil of olive. Pulse increased to 60 per minute, excellent anesthesia. The operative procedure lasted about an hour. In the night bloody diarrhoea commenced which lasted 3 days at the end of which the patient died.

**CASE 4.** A. P. (man) single age 30 (Colombian) half-breed. Subtotal abdominal hysterectomy and appendectomy for tuberculosis. November 9, 1904. Vermifuge purge of calomel and santonin in evening. Intestinal lavage and injection of morphine atropine before enema of 30 grains of ether and 4 of oil of olive. Ten minutes after the pulsation increased to 93 and she commenced to sleep. A compress was placed to the right of the characteristic odor of hich was noted. Etherous gas passed per rectum and there as vomiting and colic prior to narcosis. At the suturing of the walls the patient

in could become lightly sensitive and I drop the chloroform re-administered. Consciousness as normal. The patient left the hospital early.

**CASE 5.** E. S. (man) age 35 (Colombian) half-breed. On November 10, 1904, the right parotid the submaxillary, external leptomastoidian muscle were resected. The external carotid internal and external jugular were ligated and resected all were commencing to be invaded by an extensive carcinoma which up to now had not recurred. I did not purge, testinal lavage and injection of morphine atropine before enema of 35 grains of ether and 4 of oil of olive. Testinal colic followed the pulse 1 time rapid and minutes later sleep profound. Anesthesia as ideal for hours. The patient kept the rest of the lavage, regular pulse and respiration. Consciousness as normal. Anesthetization took place per rectum and the patient left the hospital after 30 days.

**CASE 6.** F. C. (man) age 30 (Colombian) hit. On November 13, metastasis resected for osteitis. Following purge as given. Intestinal lavage and injection of morphine atropine were done previous to ether enema of 40 grains of oil of olive to 20 grains ether. Pulmonary respiration normal. There followed colic and desire to return. Consciousness as normal and the patient left the hospital early.

**CASE 7.** P. P. C. (man) age 30 (Colombian) hit. Neglected for left tuberculous. November 15, 1904. For the right, as given. Intestinal lavage and injection of morphine atropine were done before enema of 20 grains of ether and 4 of oil of olive given. Anesthesia as complete. 20 minutes. There as post-



M. L. operated on February 9, 1906 for reestablishment of normal oral orifice (Case 8).

anæsthetic vomiting the rest of the day. The patient left the hospital in a month.

CASE 8. J. de la C. E. man age 45. Colombian white. November 29, 1915. extirpation of an epithelioma of the right lower eyelid with indispensable blepharoplasty. Evening purgation. On the day of operation intestinal lavage injection of morphine-atropine and enema of 120 grams of ether and 40 of olive oil. Intestinal colic followed with pressing desire to evacuate. The patient was hilariously excited for about an hour for which some drops of chloroform were given and he promptly became quiet. The operation lasted 45 minutes. During the night there was rectal tenesmus and 5 bloody stools were passed for which 50 grams of olive oil with 20 drops of laudanum were administered. The diarrhoea lasted 2 days. The patient left the hospital well.

CASE 9. M. A. housewife age 65. Colombian white. December 1, 1915. resection of right portion of lower maxillary bone for sarcoma. Calomel and santoin purgative were given in the evening. Rectal lavage and morphine with atropine before oil ether enema of 50 grams olive oil and 125 grams ether. Intestinal colic followed. The pulse was 80. Anæsthesia was complete in 5 minutes. On the following day right hemiplegia and aphasia were present diarrhoea until the fourth day when the patient died. There were no cerebral antecedents. At necropsy meningeal adhesions were found and a small abscess of the left frontal lobe.

CASE 10. R. L. woman single age 33. Colombian half breed. In December 1915 subtotal abdominal hysterectomy with appendectomy for bilateral adnexitis and tubercular appendicitis were performed. Evening purgation. Rectal lavage and hypodermic injection of morphine-atropine were given before starting the enema of 120 grams of ether and 50 of olive oil. The pulse was 75 per minute perspiration was profuse. During the night enterorrhagia was so severe that neither ergot nor an enema of olive oil and laudanum could stop it. Hematuria was present during the following days with ecchymous and purpura patches in the skin. The patient died on the third day. Necropsy showed the liver small and some what degenerated.

CASE 11. M. A. J. man age 40. Colombian white. December 3, 1915. radical operation for a large inguinal hernia. An evening purge of 30 grams sulphate of soda. Rectal lavage and injection of morphine and atropine were given before enema of 125 grams ether and 50 of olive oil. Nauseas and intestinal colic followed on giving the ether. The pulse was 60 per minute perspiration was profuse. Anæsthesia was excellent in 10 minutes. There was exaggerated meteorism at the beginning of the operation. Convalescence was normal and the patient left the hospital well.

CASE 12. M. L. man age 42. Colombian negro. February 3, 1916. naso-oral plastic operation for reestablishment of the orifices one being completely occluded. There was also an almost total stenosis in the other due to a vicious cicatrization following (see the accompanying photograph). Evening purge of 135 ounces of castor oil which was aspirated by means of a rubber tube. Rectal lavage and morphine atropine injection were given before oil ether enema of 100 grams ether per 60 of olive oil. Anæsthesia was complete in 10 minutes and lasted an hour. As the operation was not concluded a second enema of 50 grams of ether for 30 of oil was given. Three days suffered from dysenteric diarrhoea. Recovery.

#### REMARKS

Of the 12 cases that were operated on under rectal anæsthesia ether 5 were women of 26

to 65 years and 7 men from 19 to 55 years. The quantity of ether varied from 100 to 150 grams thus in one 100 in six, 120 in four 125. In one 2 enemas were used the first being of 100 and the second of 50. In none of the cases was chlorotone used prior to the enema to obviate rectal intolerance toward ether neither was rectal lavage employed at the end of intervention to wash away any excess because the dosage employed was small. Such procedures are omitted with the object of simplifying the technique and rendering it more practicable to the surgeon and tolerable to the patient. The most convenient quantity of ether appears to be 125 grams or about 4½ ounces with 2 ounces of olive oil. The anæsthesia thus obtained is sufficiently profound for an operation lasting 2 hours. If a small quantity of ether is used it is well to place a compress on the face as a precaution.

For the evening purge I have employed castor oil in 8 sulphate of soda in 1 calomel with santoin in 2 and in 1 case I gave no purge. The cleaning out of the rectum is an indispensable requirement, and the best purgative appears to be Glauber's salt because calomel irritates the intestine and produces a dysenteric form of diarrhoea *per se* especially when there is great abundance of intestinal parasites. The routine in my service before all abdominal operations is to give a lumbricidal purge of calomel and santoin, with the object of obviating post operative vomiting and the *uscardian* peritonitis which is very frequent in such operations unless such precaution is taken.

After the oil ether enema 6 of the patients suffered from intestinal colic with a desire to evacuate in 3 there was anal flatus 2 showed moderate vomiting at the beginning of the anæsthesia, and there was only 1 post anæsthetic vomiting. Difficult anæsthesia with hilarious excitation in 1 deficiency at the end in 2. In these two a few drops of chloroform were used. Analgesia was produced without complete anæsthesia in 1. The pulse was increased in 5. There was profuse perspiration at commencement of anæsthesia in 2 exaggerated meteorism in 1. After the administration of the oil ether enema anæsthesia appeared in 30 minutes in 5 cases in the others in about 15 minutes. The anæsthesia was excellent lasting about 2 hours in 6 cases. In one I had to repeat the ether enema.

#### MORBIDITY AND COMPLICATIONS

Among the gravest complications of rectal anæsthesia by oil ether mixture is in the first place the irritation of the intestinal mucosa which may be very violent in some individuals. Of the



cases cited in this study 4 developed dysentery form diarrhoea in the days following and one case 7 ventable hemorrhage none of these previously showed the least lesion of the rectal mucosa a condition which *a priori* contra indicates this type of anesthesia. Objection may be raised to the fact that in 1 case I omitted rectal lavage at the end of the operation and that I did not give the three ounces of olive oil which Dr Gvathmev prescribes. However in 4 patients operated on under this anesthetic to

which Dr Jose Maria Montoya of Bogota alludes final lavage was done and the oil was given and 1 of 2 of these cases there occurred dysentery form diarrhoea for 3 to 5 days.

#### MORTALITY

In Case 3 a patient of 37 years operated on for an infection of the lower leg death occurred on the third day the patient being exhausted by bloody and persistent diarrhoea. The patient in Case 9 65 years old who had a resection of part of the lower maxilla died after four days of hemorrhagic diarrhoea with aphasia and hemiplegia and eight days after intervention.

In Case 10 the patient 33 years of age who had an abdominal hysterectomy for bilateral adnexal tuberculosis died on the third day of enterorrhagia. Hematuria was present and there were purpuric spot on the skin symptoms of a

hemolysis evidently due to a hepatic insufficiency provoked by ethenic intoxication. There was no family history of hemophilia.

These 3 deaths can certainly be attributed to the rectal anesthesia by ether because the most serious intervention was the hysterectomy in Case 10 and I have done so far this year 14 similar operations using other methods of anesthesia without a single death.

#### CONCLUSIONS

1 Rectal anesthesia with an oil ether mixture in a quantity proportional to the weight of the patient is simple and sufficient tranquil deep and prolonged sleep follows the dose.

2 Its disadvantage is the predisposition to diarrhoea and enterorrhagia by which is caused the irritation of the rectal mucosa.

3 Post operative morbidity and mortality with rectal anesthesia appears to be greater than with the methods commonly used. It seems contra indicated in infections and in tuberculous cases also in the aged.

4 At present and until some means are found to suppress the irritation which ether produces on the rectal mucosa rectal anesthesia will be an exceptional procedure which ought only be employed in operations on the naso-oro-pharyngeal cavities free and some parts of the neck especially when the surgeon lacks a competent anesthetist.

## CLOSING THE SKIN IN ABDOMINAL INCISIONS

BY CHARLES STANLEY WHITT M.D. F.A.C.S. WASHINGTON

THE methods of closing the skin in abdominal incisions are almost as numerous as the operators and just so long as the conditions vary and fancies are indulged just so long will this condition exist but an approach to standardization is both possible and desirable. The technique is changed from time to time for very good reasons and not infrequently abandoned methods are rejuvenated and given a substantial place in the present day methods. The bacteriology of the skin has been largely responsible for modifications of technique and the introduction of iodine as a sterilizing agent has permitted greater latitude in the use of sutures which penetrate all layers of the skin.

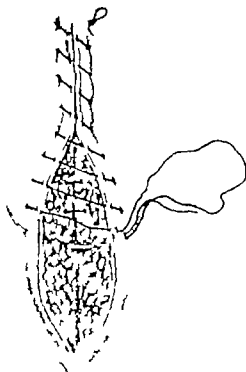
There are certain fundamental principles chiefly mechanical that have varied little in the evolution of the closure of the abdominal wound. Any closure which approximates the deeper layers without undue trauma with accurate apposition of the skin margins may be considered as fulfilling the surgical requirements. Much has been said and written of dead spaces in wounds offering sites for hernia, blood clot, and infection. Such a space may exist not only in the deeper layers but in the subcutaneous layer as well because the areolar tissue binding the skin to the fascia is of a loose and elastic texture and the use of retractors and towel clamps coupled with disregard of gentleness in manipulation traumatizes and creates spaces in the subcutaneous layer. A pocket of this sort is a nidus for a mild infection or an annoying hematoma. Closing of the skin implies approximation of the subcutaneous layer as the two are so intimately blended and this is generally accomplished by one suture but a means of fixing the subcutaneous to the fascia beneath must be provided.

Probably the most convenient method is the through and through tension suture or figure of eight all of which in a measure are satisfactory and accomplish the same end that is approximate the fascia edge and at the same time bind the layers in a vertical line, eliminating dead spaces in both planes. We look upon the figure of eight as the best of the deep sutures and a necessary one in routine practice, referring the B and B tension suture (silk with special treatment) on account of its tensile strength, smoothness and uniformity in size and satisfactory sterilization.

If a deep suture is used passing through the skin, subcutaneous layer and fascia the closing of the skin is largely a matter of approximation. We do not believe that great tension should be used in bringing the edges of the skin together; the pressure of a tightly drawn stitch deprives the tissue of an adequate blood supply, opening an avenue of infection by devitalizing the area adjacent to the suture. Common faults in skin closure are tightly drawn sutures and overlapping or inversion of the edges and while this defect may be seemingly trivial it may delay the patient's discharge from the hospital a week or more or entail dressings at the home.

The suture we have found quite satisfactory is one which may be termed a continuous vertical mattress. The material usually employed is No 00 or No 000 chromic catgut though fine silk or linen under some conditions is preferable. Any needle of small diameter straight or curved may be used, this being a matter of personal choice.

The suture should have a knot or small loop tied in the long end or fixed by a split knot and



Author's technique

be begun by taking a deep suture to include the entire thickness of the skin from one side of the incision to the opposite about one centimeter from the edge. The needle is then reversed in the holder and the suture passed obliquely toward the other side or the side on which the suture was started barely engaging the edges of the wound. The needle is then introduced a trifle lower on the side on which it originally entered one centimeter from the edge and the first deep suture is repeated. These deep and superficial suture are continued until the wound

is closed drawing up the thread gently as each suture is completed.

The advantages of suture are ease and rapidity of application and perfect approximation of the edges. Some slight modification may be required for individual cases picking up the edge of the fascia in the deep portion of the stitch is possible in thin individuals.

We have not seen this suture described or used elsewhere nor has any effort been made to trace the origin but we are willing to believe that it was in daily use by Hippocrates.

## DESCRIPTION OF A NEW METHOD OF TURNING DOWN BONE FLAPS ON THE SKULL

B. R. FARR, M.D., NEW YORK, N. Y., 1907

THE great number of methods employed in opening the skull is an eloquent proof of the shortcomings of most of the methods employed. Aside from the question of hemorrhage the proposition of entering the cranial cavity through its bony protecting wall without injury to the underlying soft tissues has tested the ingenuity of surgeons as long as surgery has been known. The Doyen burr of which the Hudson drill is a modification in conjunction

with the Gigli saw or forceps of Dahlgren or De Villos have proved up to the present time perhaps the most satisfactory. For many years surgeons have attempted to use circular saws driven by some form of motor power but with rather unsatisfactory results on account of the danger from these instruments.

The simple act of making a trephine opening into the skull has been so simplified by the introduction of the DeMartel drill that this may



Fig. 1.  
Dural guard for motor saw

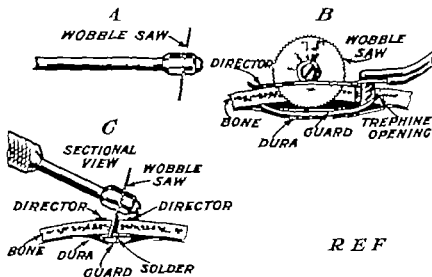


Fig. 2.  
Application of motor saw and guard

R E F

be done by electro motor power without danger of injury to the dura

The instrument which I have designed may be introduced through a five eighth inch trephine opening and slipped along between the skull and dura for approximately  $2\frac{1}{2}$  inches. It has two flexible metal guards which indicate upon the outside of the skull the exact location of the dura guard beneath. With a  $1\frac{1}{2}$  inch motor driven saw the bone may be divided along the line of the guard for the distance over which the dura is protected. The shank of the guard is made sufficiently thin so that it will travel along the groove cut by the saw as the guard is advanced to a new position. Repeating this movement the bone flap may be outlined and raised in a very few minutes and with the minimum of trauma and physical exertion, and with safety. In order to advance the guard into a new position it is desirable to cut a rather wide channel in the bone. To meet this condition, I have made use of the wobble saw by means of which a channel of any width may be cut. The width of the channel will depend upon the angle at which the saw is set on the arbor.

These dura guards are made in three forms. One is straight, one is curved to the right and the other to the left (Fig 1). This makes it possible to cut a channel in any direction desired.

The guard proper is concavo convex and the concave trough is filled with solder so as to protect the teeth of the saw provided they happen to come in contact with the guard.

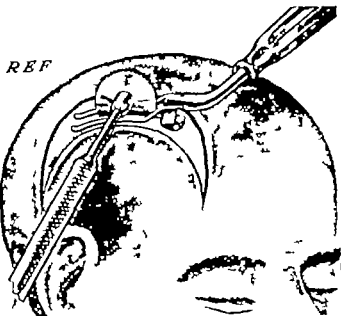


Fig 3 Guard in action

Figures 2 and 3 show the application of the motor saw and guard in action.

I have used this guard repeatedly upon the cadaver and have raised large bone flaps in three cases upon the living subject. These flaps were all turned down under local anesthesia and the guard seemed to work very satisfactorily.

As an additional safeguard the patient's head may be protected by a piece of sterilized lead plate  $\frac{1}{8}$  inch in thickness to prevent the revolving saw from getting caught in the drapes as described in a previous article.<sup>1</sup>

GARR R E Ann Surg Phila 9 3 June

## A SIMPLE AND EFFICIENT PREPARATION OF THE FIELD OF OPERATION

BY G S FOSTER M D MANCHESTER NEW HAMPSHIRE

Surgeon and Pathologist to Hospital Notre Dame de Lourdes

TODAY we find every line of work evolving into efficiency and simplicity. Surgery is no longer a delinquent. Possibly it could be considered the leader.

To make efficient and yet nominally simple, the preparation of the field of operation has been our hobby for a few years past. Gradually but surely we have succeeded in eliminating many of the superfluous actions of former days. The writer has for two years past instituted the foregoing method for the preparation of the field of

operation. Because of its extreme simplicity and effectiveness, minus any discomforts, the writer desires to make this report hoping that others may think well enough of it to adopt its principles.

The following is a detailed description of our *modus operandi*.

The evening before the operation the field is carefully shaved and well sudsed. It is then rinsed with sterile water and carefully dried with sterile towels after which it is covered with dry

sterile gauze and a bander applied to keep the gauze in place. This is all the preparation made before going to the operating room.

Upon the operating table when the patient is yet but semi-anesthetized the field of operation is made bare and all covering is rolled off with carefully placed sterile towels. The dry field of operation is then carefully and thoroughly bathed with gasoline. The greatest care is taken to see that any minute areas are not overlooked and special attention is given to the umbilicus and pubic vibrissae as we believe that these parts should be supersaturated. The gasoline coat is wiped off very thoroughly with sterile gauze and the entire field is then carefully bathed with 10 per cent alcohol which is allowed to remain without being dried. The field is now ready for the final protective linen walling and the incision.

We have found this method to be most satisfactory. During the eighteen months that we have been using the technique we have noted but a very pleasant appearing skin area after the operation.

#### RESUME

1 The preoperative preparation on the eve of the operating day does not necessitate the submitting of the patient to anything disagreeable.

The dry sterile dressing aids in inducing pleasant and restful sleep for the night before.

3 On the operating table the patient can be prepared in a space of time not exceeding two minutes.

4 No wet or soiled table pads and linen are present for the patient to lie in during the operation.

5 The very light touch and gentle care used upon the table during this preparation permits silence thus avoiding any unnecessary noise.

6 The trained anesthetist can run the patient along very lightly so that but a minimum of the anesthetic is used.

In no instance has the skin become irritated in the least.

8 The technique is so simple it should encourage others to make use of it.

## ECTOPIC PREGNANCY FOLLOWING LIGATURE AND SECTION OF UTEROPILIAN TUBES

By JAMES C. WOOD, M.D., F.A.C.S., CLEVELAND, OHIO

THE following case, in view of the fact that there is now under discussion in medical literature the various methods of permanently producing sterilization, is I think of interest.

Patient No. 34, referred by Dr. W. L. Wells of Cleveland, Ohio. One child thirteen years ago, the result of very hard instrumental labor, the cervix being lacerated and the levator ani muscles separated. When she came to me in January, 1913, there was complete hernia of the pelvic organs, the uterus, vagina and bladder presenting externally. The fundus was back and and there was hypertrophic elongation of the cervix.

On January 29, 1913, I divided the uterus, cut and applied iodine to the endometrium for the menorrhagia, amputated the cervix, did anterior colporrhaphy by removing an ellipse of mucous membrane and fascia approximating the wound thus made with three sutures in such a way as to bring into contact at least one half inch of raw area and built up the pelvic floor by the flap splitting method. I then opened the abdomen and after removing the appendix did the internal Alexander operation. The patient was exceedingly anxious not to become pregnant again so that I folded each fallopian tube upon itself with Pagenstecher ligature and popped off the loop of tissue thus created with pairs of scissors, method which I had many times followed.

The patient recovered completely from the operation and as perfect health for six months. I saw her again the latter part of October, 1913. Three months previously she had missed a period and had many of the real symptoms of normal pregnancy. The uterus, however, still appeared empty. She continued to feel bad and had several sharp attacks of pain, the right side the last one occurring the day before I operated. There was clearly

mass of some kind intimately in contact with the upper right side of the uterus. I removed her to the hospital and on November 1st reopened the abdomen through the right semilunar space to find an unruptured ectopic pregnancy located near the uterus in the proximal end of the right fallopian tube. There was general inflammatory condition also of the uterus and abdomen. The tera being intimately fixed to the abdomen by the previous operation. My dissections had to be overcome and the bleeding as very profuse. An eight weeks fetus with its membranes intact was removed with the tube. All active bleeding points were secured in ligatures. The oozing, as of such character that I deemed it best to pack the raw areas and drain through the vagina. The patient also made an excellent convalescence from the operation and is again perfect in health.

Dr. Robert L. Dickinson in his excellent review of the subject in the August, 1916 number of SURGERY, GYNCOLOGY AND OBSTETRICS under the caption of Simple Sterilization of Women

by Cautery Structure at the Intra Uterine Tubal Openings Compared with Other Methods has shown that pregnancy following the procedure adopted by me for the purpose of inducing sterilization is of the rarest occurrence. On the other hand he has shown that subsequent disease of the tube with distention occasionally occurs. He has however in his review of the subject evidently not found recorded any case of ectopic pregnancy resulting from tying off the tubes with section and it is for this reason that I place the foregoing case on record.

There can be no question if the abdomen is opened for other purposes but that section of the tubes is the most satisfactory of all methods of inducing sterility. I have however in all instances since my unfortunate experience in the case recorded burned the proximal end of the tube in the folds of the broad ligament leaving the distal end after cauterization with carbolic acid free.

I assured the patient that conception was impossible and as a consequence a malpractice suit seemed at one time inevitable.

## CORRESPONDENCE

### THE WIRE GAUZE BRAIN DRAIN

To the Editor. In the December 1916 issue of *Surgery, Gynecology and Obstetrics* p. 740 Dr H. P. Mosher refers to the treatment of cerebral abscess by a perforated metal tube filled with glycerine but states that he does not know with whom this method originated.

The treatment is described by Sargent and Holmes in their article on Penetrating Wounds of the Skull in the *British Journal of Surgery* of January 1916. The tube used by them is cylindrical not conical as stated by Dr Mosher.

The writer has recorded in the *St. Bartholomew's Hospital Journal* of September 1916 a case of gun

shot wound of the skull operated on six months after the injury in which an abscess of the right frontal lobe was treated by the perforated metal tube and glycerine. The patient died six days after operation, death being caused by two large right sided temporoparietal abscesses which had produced no localizing symptoms, did not appear in the skilgram and were undiagnosed. The autopsy showed that in the frontal lobe there was no meningitis and but very little softening of the action of the perforated tube and glycerine having provided satisfactory drainage.

C. HAMILTON WHITFORD M.R.C.S. L.R.C.P.

Plymouth England

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

CONSTITUTION, OBSTINATION AND INTERNAL STABILITIES. By Samuel Goodwin Grant, M.D., LL.D., 2d ed. enlarged. Philadelphia and London: W. B. Saunders Company, 1916.

TRANSACTIONS OF THE SOUTHERN SURGICAL AND GYNECOLOGICAL ASSOCIATION. Vol. XXVIII. Philadelphia: Wm. J. Dorman, 1916.

PHARMACOLOGY AND THERAPEUTICS. By Horatio C. Wood, Jr., M.D., 2d ed. Philadelphia and London: J. B. Lippincott Company, 1916.

LITTACOTT'S NURSING MANUALS—CARE AND FEEDING OF INFANTS AND CHILDREN. A textbook for trained nurses. By Walter Reeve Ramsey, M.D. Philadelphia and London: J. B. Lippincott Company, 1916.

STIMULI. By Lloyd Thompson, Ph.D., M.D. Philadelphia and New York: Lea & Febiger, 1916.

GYNECOLOGY FOR STUDENTS AND PRACTITIONERS. By Thomas Watts Foden, M.D., F.R.C.S., R.A.M.C., and Cuthbert Lockyer, M.D., B.S., F.R.C.S., and L.R.C.P. New York: The Macmillan Company, 1916.

TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION. Edited by John F. Binnie. Vol. XXXIV. Philadelphia: Wm. J. Dorman, 1916.

GUNSHOT INJURIES. By Colonel Louis A. LaGarde, 2d ed. New York: William Wood & Co., 1916.

LOCAL INFECTION—THE LANE MEDICAL LECTURES. By Frank Billings, Sc.D. (Harv.). M.D. New York and London: D. Appleton & Co., 1916.

THE PRACTICAL MEDICINE SERIES. Vol. VII. OBSTETRICS. Edited by Joseph B. De Lee, A.M., M.D., with the collaboration of Herbert B. Stowe, M.D. Chicago: The Year Book Publishers, 1916.

A PRACTICE OF GYNECOLOGY. By Henry Jellett, M.D., F.R.C.P. Philadelphia: Lea & Febiger, 1916.

A TEXTBOOK ON THE PRACTICE OF GYNECOLOGY FOR PRACTITIONERS AND STUDENTS. 6th ed. thoroughly revised. By William Easterly Ashton, M.D., LL.D. Philadelphia and London: W. B. Saunders & Company, 1916.

CARE OF PATIENTS UNDERGOING GYNECOLOGIC AND ABDOMINAL PROCEDURES BEFORE, DURING AND AFTER OPERATION. By E. E. Montgomery, A.M., M.D., LL.D., F.R.C.S. Philadelphia and London: W. B. Saunders & Company, 1916.

# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNCOLOGICAL SOCIETY

REGULAR MEETING HELD SEPTEMBER 15, 1916 WITH THE PRESIDENT  
DR. CHANNING W. BARRETT IN THE CHAIR

### PITUITRIN IN LABOR

DR. JOSEPH B. DE LEE: I would like to put on record a case that occurred recently at the Chicago Lying-in Hospital which will be very useful in judging of the dangers of pituitrin in labor.

A woman with her second child had a very difficult instrumental delivery which was followed according to her statement by peritonitis from which she recovered after a long illness. In her third pregnancy a contracted pelvis was discovered and cesarean section at term just as labor began was recommended. She neglected to enter the hospital till well advanced in labor and cesarean section was prepared for. Owing to an oversight which was very fortunate in this particular instance the preliminary injection of ergot was omitted. The abdomen was opened in the usual manner. The incision was to perform cesarean section by the transverse physical transperitoneal method as recommended by Doederlein and Kroenig. Upon opening the abdomen a hematoma was discovered under the bladder. We cut into it very rapidly and within 15 minutes had begun to rupture. An opening about 1 1/2 inches long having already occurred. The uterus was incised in the median line and very deeply asphixiated child extracted. The child was resuscitated carefully. The rupture extended to the right into the broad ligament under the base of the bladder and had taken place in a scar composed of the lower uterine segment and the bladder wall.

It has been the practice of many physicians in performing cesarean section to give in addition to the preliminary dose of ergot a dose of pituitrin before opening the abdomen and this case shows that had such a dose of pituitrin been administered in all probability when the incision was made the child would have been found free in the peritoneal cavity and a very extensive rupture of the lower uterine segment and bladder would certainly have taken place.

The lesson which I would wish to draw from the case would be that—

1. In general the use of pituitrin should be restricted.

In particular those cases that have previously had difficult deliveries its employment should be especially safeguarded.

### ADVANCED EXTRA UTERINE PREGNANCY WITH LIVING CHILD PRIMARY LAPAROTOMY

DR. W. GEORGE LEE read an inaugural thesis entitled "Advanced Extra Uterine Pregnancy with Living Child Primary Laparotomy" (See p. 317)

### DISCUSSION

DR. N. SPROAT HEANEY: We are grateful to Dr. Lee for having presented this interesting subject to us this evening and I think he had rendered particular service by discussing the choice between marsupialization and direct removal in such a clear way. It would seem absolutely clear that marsupialization is only to be used when direct removal is not feasible. I did not know before just how rare these cases were and I therefore wish to put on record a case I saw with Drs. Besley and Richter some three years ago.

A young woman never pregnant before was admitted to Dr. Richter's service at Wesley Hospital. She gave a history typical of ectopic pregnancy. She had several attacks of sudden pain, syncope, prostration, irregular bleeding and slow recovery from the attacks so that the case should have been diagnosed in the early months. The last acute attack was upon the day of her admittance to the hospital. The abdominal tumor was the size of a 28 to 30 weeks gestation, the pulse was rapid and of poor quality, the temperature subnormal and the hemoglobin was 5 per cent or less. The cervix was flat and lay high up close to the symphysis while the cul de sac was markedly bulging. Heart tones were not elicited. Ectopic pregnancy was diagnosed but no one doubt existing as to the possibility of a prematurely separated placenta of an intra uterine pregnancy, the cervix was gently dilated and an empty uterine cavity being found the diagnosis was cleared. Since the patient's condition had so markedly improved from the time of her admission until the next day when I saw her we agreed to wait for further improvement before operating upon her since this seemed less dangerous than operating immediately with so low hemoglobin. Four days later she had a sharp rise in temperature and since her hemoglobin had increased twenty points immediate laparotomy was done by Dr. Richter. The

gestation sack lay to the left of the markedly enlarged uterus in the broad ligament and filled the entire cul de sac. The sack was intact except for a rupture which allowed the amnion to bulge through an area about two inches in diameter. The sack was opened and the foetus was delivered and it did not seem possible that it could be alive it was put in a specimen pan. The placenta was easily removed from the interior of the sack without much bleeding. The posterior wall of the sack was then cut away the anterior wall being left as a broad ligament. The abdomen was closed without drainage. The foetus however manifested feeble signs of life and lived for some few hours. It weighed about three pounds and was extensively deformed. Ankylosis was so general that the child maintained the flexed intra uterine posture. The chest was caved in on one side and the head was lopsided thus all because of limited amniotic capacity.

Since this patient recovered it is hard to make severe criticism of the treatment. Certainly no fault should be found with the operation since it was beautifully and skilfully performed however since the amniotic sac was actually bulging into the peritoneal cavity it was easy to see during operation that had any trivial force occurred during the four days of waiting rupture of the sack would have occurred and the patient could hardly have been operated upon soon enough to save her life. Therefore I think our result here must be considered fortunate under the circumstances. Whether advanced or early I believe that fewer pangs of regret will come if every case is operated upon without such delay.

DR. GEORGE DE TARNOWSKY. Dr. Lee's case is extremely interesting to me because I was fortunate enough to see Dr. Green's case of the Ravenswood hospital as well as the one which formed the basis of his own thesis and the contrast in the operative treatment of the two was so marked that I felt that I had learned a great deal.

It seems to me the whole problem is one of extra uterine placental circulation in other words having opened the amniotic sac without disturbing the placenta the operator must primarily search out the source of his placental circulation and arrest it. In Dr. Lee's case the main supply of the placental circulation apparently came from the broad ligament and was low down in the pelvis and I think the mistake made there if any was made was in attempting to remove the placenta without first locating the site of the placental circulation. Certainly Dr. Lee's figures point conclusively to the greater safety of radical extirpation as contrasted to the older method of Pozzi or marsupialization.

DR. JOSEPH B. DRILE. I believe that the chances for the child are so small that it would be wiser to concentrate our efforts to save the mother in a case of extra uterine pregnancy and operate as soon as the diagnosis is made not waiting until the child is fully developed in order to preserve the little speck

of life which it might have. Secondly I agree with the essayist that it would be a wiser thing not to wait for decomposition to set in before operating. I must confess as we all have to do that these opinions are more or less the result of reading rather than actual experience because few of us have the opportunity to see many cases of this kind. My own experience with advanced extra uterine pregnancy comprises two cases. One was in a patient referred by a surgeon for an incarcerated retroverted uterus. I found an extra uterine pregnancy on top of the uterus and the child was viable at the time of the first examination but died and the operation was simple. The removal of the child and the placenta which was attached to the anterior surface of the retroverted uterus and left broad ligament was very easy.

The interesting feature of this case was not the extra uterine pregnancy so much as the cause of it. The woman had had an appendicitis and had been operated on a sponge had been left in the abdomen around which an abscess had formed and this abscess had shut off the tube and thus produced the extra uterine pregnancy. The sponge abscess and extra uterine pregnancy were all removed the abdomen closed up tight and the patient made a good recovery.

The other case was one in which a diagnosis of extra uterine pregnancy was made in the third month and operation advised but the family physician opposed it since the diagnosis was not absolutely positive. At seven and one half months of pregnancy with viable child the patient came to operation because of very continuous abdominal colic and sleeplessness general abdominal distress with peritoneal irritation. On opening the abdomen the placenta was found attached almost exclusively to the omentum and the blood vessels consisted simply of one layer of endothelium and the least touch caused a terrific hemorrhage which negated all attempts to stop the flow. I was the assistant somebody else did the operation. The patient bled so much that nothing could be done. The operator packed in towels and dressings and everything else that was handy and was sterile but the patient continued to bleed and died. I suggested we go into the sac and clamp the aorta as she was dying on the table and we might as well take a chance in that fashion. The husband overhearing that remark positively refused to allow us to do it. She died a few hours later in bed.

In view of the latter case which emphasizes the dangers of waiting thus permitting an immense development of omental vessels defying all efforts made to stop hemorrhage and in view of the first case in which even though under observation the child died and decomposition set in which made any operation very dangerous I believe it best not to wait in these cases but interfere as soon as possible.

DR. W. GEORGE LEE (closing). After looking over these cases I was impressed by the fact that



many of them arrive at their final operation largely through failure to make a diagnosis at the time when we all agree that operation should be done.

As to resorting to immediate operation rather than waiting for viability of the child it seems from the cases I have gone over that the waiting does not increase the risk very greatly. Probably in the case Dr DeLee cites earlier interruption would have prevented some of the difficulties encountered later except in a slight degree in the size of the vessels. The danger arises very largely in the individual case in the peculiar localization.

In the particular case I reported I think the location of the child is of special interest as shown by the X-ray photographs and also the fact that the head was completely under the costal margin and one arm extended straight across under the liver. This accounted for the marked distress but even before this obtained in considering the possibility of extra uterine pregnancy the diversity of opinion among those seeing the case was very radical and the final diagnosis of extra uterine pregnancy was made by emptying the uterus.

With reference to the remarks made by Dr Tarnowski in regard to Dr Green's case the operation was performed seven weeks after foetal death and there were no signs of foetal life after the spontaneous labor. The patient fell into labor at the specified time but the pain ceased and no more attention was paid to her. Dr Green saw her after another physician had been called in. These spontaneous labors mark the cessant of foetal life.

#### ANENCEPHALY SUCCESSFULLY DIAGNOSED BEFORE BIRTH PRESENTATION OF ROENTGENOGRAMS

DR JAMES T. CASE, Battle Creek, Michigan, read a paper entitled "Anencephaly Successfully Diagnosed Before Birth Presentation of Roentgenograms" (See p. 31).

#### DISCUSSION

DR W. A. NEWMAN, DORLAND: Dr Case's paper is one of exceeding interest. I have long felt that there are two distinct aspects to ontogenology as applied to obstetrics and to teratology especially. The first of course is the diagnosis of the condition before birth. I do not know whether there can be very much progress made in this line or not. The plates we see tonight are very suggestive with the specialization of portions that might come out. I do believe however that all monsters after birth should be investigated by the X-rays.

I reported a little over a year ago three monsters in which the skulograms were made and one of them showed something which was of unusual interest. It was a case of acephalus, one of twins. I do not know that anything could have been seen if the rays had been applied before birth. That specimen supposed to be acephalic was found to be crypto-

cephalic, the head being completely encased within the pyramid of the so-called thoracic cavity. The question therefore arises: are all these acephalic monsters in reality cases of cryptocephalus? The X-rays will decide this point.

These specimens are generally kept in museums preserved intact so that their true anatomy is not known.

DR N. SPROAT HEANEY: Some three years ago I exhibited a specimen to this Society which showed anencephalus, spina bifida and marked deformities due to unsmooth adhesions. At that time I spoke of an X-ray having been taken of the fetus in utero. The patient, an elderly primipara and had been entirely normal until about the seventh month when a rapidly increasing hydramnios appeared. Since it was especially desired to prevent a premature labor if possible the patient was limited in activity and placed on sedatives. Her discomfort increased so that it was certain that if premature labor was to be prevented more active measures were necessary. Bearing in mind the frequent deformities that accompany acute hydramnios it seemed best to ascertain if possible if the fetus were worth while before going to great extremes to prevent premature labor. I had in mind especially the chance of hydrocephalus. Accordingly Dr Potter made X-ray plates for me and he was to show them to you tonight but did not bring them along. The skeleton showed up well except the cranial vault was missing. We at once ruled out the possibility of hydrocephalus and though Dr Potter cautiously asked if I supposed that the child could be without a head we were not bold enough through previous experience to diagnose a fetus anencephalus outright. I however allowed the patient to resume her normal activities and she gave birth two or three days later.

This case and an experience with Dr Palmer Findley has led me to have X-ray plates made of all cases where we contemplate doing an elective cesarean section. Several years ago Dr Findley had a patient come to him in Omaha from a great distance. She had had two or three pregnancies which had terminated in operative deliveries and dead babies. Since she was elderly and showed some slight degree of pelvic contraction it seemed advisable to do a cesarean section. The time of operation was for some reason postponed from time to time when one night the patient entered into labor and confined herself of a fetus anencephalus. We had to huddle when we considered how near she came to having a cesarean section.

Especially serviceable is the X-ray in determining the existence of twin pregnancies and the presenting pole in doubtful cases. Recently Dr Potter sent me a note about a patient in whom I suspected twins saying "Twins are present the first is in L.O.A. the second is a breech." Examination of the plates left no room for doubt, the images were so clear.

One point of particular interest in Dr Case's

plates is the clear demonstration of the abnormally large shoulders. We know that the fetus anen cephalus is so liable to have this overdevelopment. You perhaps noticed that the clavicles were huge, very dense and as long and broad as the humeri.

Dr Dorland's suggestion that we would learn much if we were to examine all preserved mon stroustics by the X ray is I think a valuable one.

Dr JOSEPH B. DELEF Since the first intro duction of this wonderful means of diagnosis I have been particularly interested in the X ray in obstetrics and have done considerable experiment ing. Unfortunately I have never had a print of my own and have had the work done by various X ray operators.

One of the first things I tried to work out was whether we could not diagnose the age of the child for medicolegal purposes as to determine the legitimacy of the child by means of the X ray in discovering points of ossification. After sixteen or twenty plates had been made of various aged fetuses it was found futile because the regularity of the appearance of the ossification centers was not at all definite. Some children at seven and one half months have denser points of ossification than others at eight and one half months or at term.

The next thing I tried to work out was the diagno sis of intracranial hemorrhage in the newborn and only once have we succeeded in getting a crack in the baby's skull. With the perfection in technique we ought to be able to diagnose these small linear fractures in connection with newborn babies. I feel convinced that we shall find a great many more in normal deliveries than we have heretofore sus pected. We will find cracks in the babies skulls and in all cases of hematoma in the newborn infants they should be sought.

Another subject I want to work on is thinning of the bones around the joints in pregnant women a sort of pseudo osteomalacia that occurs so fre quently.

Another point is the separation of the pubis dur ing labor and I hope that Dr Case will take a woman in labor and take X ray pictures of her in the course of delivery to see whether the pubis does separate during labor or not. The ancients main tained that the joints did open when the pelvis en larged. The moderns gave up this fallacy but the neo moderns believe there is such a thing as a slight separation of the pubis and it ought to be demonstrated by means of the X ray delivering the woman on the X ray table. Points in the mech anism of labor may also be thus clarified.

With reference to the doctor's diagnosis of the sex of the child by means of the increased ossifica tion in the carpal, that is a refinement of technique which in our present state of knowledge is too much to expect and especially in view of my own experi ence that the ossification of dead fetuses varies according to age.

As far as the determination of anencephalic monsters is concerned that seems to have been

demonstrated not only as feasible but actually practical. We ought to make a rule that wherever it is possible to X ray every woman that is going to have a cesarean section done.

When I was in Vienna there was a story told of one of the professors who delivered an anencephalic monster by cesarean section to the amusement of the onlookers and his own amusement. In a case like that the professor is a little to blame because it is presupposed that every practitioner before he decides on a cesarean section, has diagnosed the position and presentation to make the delivery of the child easier and in this case he might have discovered the absence of the head. He could feel neither the head nor breech but as I have said he was little to blame because sometimes it is almost impossible to do so.

I would regret to see the laboratory stealing away the obstetrician's skill in manual diagnosis. It would be really unfortunate if the laboratory were to make the obstetrician's *locus eruditus* useless. We have prided ourselves that we have eyes on the ends of our fingers that we can feel things and that this *locus eruditus* still abides with the obstetrician. The laboratory has taken away the diagnosis of tuberculosis from us it has taken away our diagno sis of pneumonia, and we will not have to percuss the chest any more for the purpose of diagnosing tuberculosis because we can see cavities in the chest by means of the X ray. All sorts of laboratory tests have supplanted our clinical methods which the French have developed so fully and which we have learned at such great expense time and trouble. And now it seems this last thing is to be stolen from us.

Double monsters might possibly be determined by the X ray and if it can be done that would be a refinement which would be a triumph indeed. If one could determine a double monster before de livery instead of doing dangerous and mutilating operations, he could deliver the monster by cesarean section intact. There is the advantage that we might get more of these monsters out alive because most of them die during delivery. Regarding the possibility of delivering a double monster by sur gical means as ultraconservationists we should de liver them by cesarean section and then cut them in two when they get out.

Another point I wish to make is that pseudo osteomalacia might have some bearing on general toxemia and in that way the X ray would touch on our chemical and biological studies.

Dr CHARLES S. BACON Attention should be called to the fact that in nearly all cases the diag nosis of anencephalic monsters can be made without the X ray. The presence of rapidly developing hydrannios in the sixth seventh, or eighth months and the absence of the findings of the head will enable one if the examination is carefully made to make the diagnosis. I have made the diagnosis in several cases. I do not believe I have ever seen a case but that the diagnosis could have been made

with proper care exercised in the examination. However that does not lessen the value of the X ray in confirming the diagnosis or in some cases in making it and I agree with everything that has been said in regard to the value of the X ray where there is any suspicion of any deformity or any unusual condition before section.

One of the abnormalities of the newborn child that is of considerable importance and one that we should keep in mind in the diagnosis is the presence of enlarged thymus or thyroid in the neck.

One of the most important places for the routine diagnosis I believe is in twin pregnancy.

Dr. HOLLIS L. POTTER: I regard to the dangers of X ray burns in pregnant cases. I wish to say that there is a case on record in the State of Oregon in which a young woman three months pregnant had some pain in the hip joint and was X rayed about five years ago by an incompetent person who used a burning dose for demonstration of the hip joint. A burn followed in a few days, but it was very severe and was not limited to the hip but extended over the whole abdomen and continued unhealed throughout her pregnancy.

An interesting thing in the case was that although she had a good deal of sloughing, she had no pain and the dose which was the most severe I ever heard of was given right through the pregnant uterus. The child was born at term with no signs of any ill effects from the X ray. That has put out of our mind the question of using ordinary doses, such as are necessary to make two or three plates in pelvic diagnosis or of ordinary twins or hydramnios or monstrosities of this sort.

I am very glad that Dr. Case has risked this thing up and after seeing one or two of these cases one must regard this method as perfectly legitimate. In the plate exhibited the head is quite visible. We can surely diagnose the absence of the cranial vault and collection of the bones of the face, such as we saw in his plates. I do not think I will ever be excused after tonight for not observing him in any ordinary case of pregnancy.

Dr. JAMES T. CASE: Battle Creek (closing). This whole study has brought to my mind forcibly one point of which I may be permitted to speak, namely very often we have eyes and see not. It comes to us every day that we look at X ray plates simply as a branch or department of other medical work. We go over these plates for a number of minutes or hours at night and do not recognize their value.

When I began taking X ray plates for instance of gall stones I had a number of friends who came to me with kidney plates and were astonished at the number of gall stones they had overlooked. I have a habit of going over plates that are three or four years old and I find lesions which I failed to recognize at first or had overlooked although I

looked over them particularly when examining patients. So it is with the plates in pregnancy cases. It is not enough to look at the pelvis or the abdomen as a whole and recognize a bunch of bones but one should follow out and make out each arm and all of the pelvic bones and be should be willing to hunt for the trunk bones.

Professor Fry or has published a monograph on the development of the epiphysis which shows great variations with the published figures in our anatomic. His figures have been used by a professor of Harvard University and I am sure that his work has been carried out on a sound basis. There is great variation in the development of the bones of the fetus in young children and this variation is hereditary. It is seen in families of several children. Each case may differ in some respects but they all follow Menetrier's law in every particular.

#### CHRONIC HAEMOGENIC SALPINGITIS

Dr. W. C. DANFORTH read a paper entitled Chronic Haemogenic Salpingitis (See p. 313).

#### DISCUSSION

Dr. CHARLES S. BACON: It is often said that the great trouble with the medical profession is that we do not study our cases logically or that we do not use logic in our ordinary work that we form conclusions on very insufficient premises. I cannot understand Dr. Danforth can hold that the infection in this particular case is haemogenic when the woman had been subjected to four or five laparotomies in each of which infection might have been introduced from the outside. We do not have to assume that infection came up through the uterus. It is very probable that infection with the streptococcus might have been introduced into the abdominal cavity and got into the tubes. It seems to me it is not logical to say that because appendicitis follows an acute tonsillar infection that therefore it is due to that.

Dr. W. C. DANFORTH (closing): I expected that there would be some difference of opinion and I quite realize the importance of Dr. Bacon's point of view. There is no mathematical way of proving that this thing did occur in the sequence in which I indicated. Inasmuch as a similar bacteriology has been found in the foci from which so many lesions in other parts of the body had been proved to come and in view of the fact bacteriologists are standing have succeeded in demonstrating some of the acute infections to follow throat infections it is not illogical to assume that some of the infections in the pelvis came from the same source although there is no way of settling it on the basis of any one case or a series of cases and I have presented the case for what it is worth.

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXIV

APRIL, 1917

NUMBER 4

## FASCIA TRANSPLANTATION INTO VISCERAL DEFECTS

AN EXPERIMENTAL AND CLINICAL STUDY<sup>1</sup>

By HAROLD NEUHOF, M.D., NEW YORK CITY

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### INTRODUCTION

AFTER the principles of free fascia transplantation had been established chiefly through the pioneer work of Kirschner fascia grafts were soon employed for a great variety of purposes. Many conditions offered possibilities for correction by fascia transplants and a considerable number of cases of successful clinical and experimental transferences into *aseptic* fields have accumulated in the literature. These studies have not definitely settled the ultimate fate of transplanted fascia but they have demonstrated clearly that, for practical purposes fascia is a remarkably satisfactory tissue for transplantation.

A field absolutely free from the likelihood of infection and rigid asepsis at operation have always been considered absolutely essential for any successful transplantation. It was therefore expected that attempts to transplant fascia into *non aseptic* areas would fail. A few successes and about an equal number of failures both clinical and experimental have been reported. Thus fascia transplantation into unaseptic fields was considered very unreliable and was practically discarded. From a survey of the subject however I believed that the question had not been investigated sufficiently. Above all it appeared of great interest from the prac-

tical as well as the experimental side definitely to determine if fascia can be safely and satisfactorily employed for bridging defects in hollow viscera. This aspect of the subject was especially considered in the work on fascia transplantation carried out in the past two and one half years and will be particularly dwelt upon. Its practical significance will appear in the descriptions of experimental groups and in the presentation of two cases, one of tracheal and one of urethral defect, to be given at the close of the paper.

Most of the experiments to be reported are devoted to the types of fascia transplantation that have hitherto failed or have not been attempted. For the purpose of arriving at a well balanced conclusion the failures as well as the successes will be emphasized.

### THE ADVANTAGES OF FASCIA AS A TISSUE FOR TRANSPLANTATION

The free transplantation of fascia is only a small part of the whole subject of tissue transplantation. There are many conditions for which fascia transplants in contrast to transplants of other tissues would be undesirable or could not be employed. When Kirschner first reported his work, he believed the procedure to be of limited practical application and value. He was led to employ fascia as a substitute for tendon defects be-

<sup>1</sup> Awarded the Bessie M. Price for 1916 of the Alumni Association of the Columbia University College of Physicians and Surgeons.

cause the quantity of tendon material that could be grafted autoplastically was very limited and because fascial tissues are so remarkably similar in anatomic structure to tendon. Since Kirschner's publication the practical uses that have been made of fascia transplants have multiplied rapidly. It is therefore pertinent to inquire into the advantages of transplants of fascia over transplants of other tissues for conditions in which up to the present time the latter have been employed or suggested. In this inquiry autotransplants alone will be considered.

Numerous experimenters (Kirschner, Davis, von Saar, Valentin, and others) have demonstrated that fascia transplants usually heal in place with practically no changes in the fascia or in the adjoining tissues. This holds true not only when the parts are at absolute rest, but also when the transplant is under tension or is altered in shape and position with the changes in the organ to which it has been transferred. These experimental observations have been supported by a number of corresponding ones in the human being. Indeed the tendency of transplanted fascia to heal in place must be extraordinarily great to account for results encountered not only in simple cases, but also when the conditions were thought very unfavorable for the success of any transplant — poor blood supply in the region of the graft, nourishment possible to only one surface, etc. An analysis of the reported cases shows that there have never been any undesirable manifestations as a result of transplanting fascia into aseptic fields.

Without entering into the vexed question of the ultimate fate of transplanted tissues, one may say that as far as fascia is concerned it has not been definitely settled. The reason for this lies in the inadequately elapsed time of observation after fascia transplantations. Within the limited period, however, most experimenters find that few, if any, significant changes are seen in the characteristic structure and staining qualities of transplanted fasciæ. Some have noted oedema of the

transplant soon after transference. Its viability does not appear to have been affected as a result except when very rarely the primary swelling was too great (von Saar). Concerning the fate of transplanted fascia in the human being, most of the examinations have been made relatively soon after operation and the fact that transplants have been found viable is no evidence of their final condition. In this connection the more prolonged observation in a case reported by Denk is of interest. He examined a sheet of fascia 11 months after its implantation into a dural defect. The transplant was transformed largely into dense fibrous tissue apparently as the result of its gradual disintegration with simultaneous connective tissue replacement. It is therefore evident that the fate of transplanted fascia is not known and that the probabilities are in favor of its ultimate death. From the practical side, however, the question does not appear to be of any great importance. There is no reason to believe that the sheet or strip of good firm tissue that may finally form, functioning as the original transplant, is less serviceable than living fascia.

In comparing autotransplantation of fascia with that of other tissues — fat, muscle, skin, peritoneum, periosteum, etc. — its practical advantages are at once evident. Besides its great tendency to heal in place, fascia requires minimal blood supply for its nourishment. It is always very readily obtainable and a factor of great importance in almost unlimited quantities. Fascia has great tensile strength and at the same time shows very little tendency to stretch or to shrink under ordinary circumstances. Lastly, it is easily adapted to the surfaces of any organ. None of the other tissues suggested or used where fascia is applicable has all these characteristics. Those approaching nearest are peritoneum (when resistance to tension is not required) and periosteum (when resistance is required). Kolaczek urged the use of transplants of peritoneum for a number of conditions because it is lined by smooth mesothelium. The perishability of mesothelial cells is very well known; in fact, Kolaczek could not demonstrate that they remained

The transplants here shown are not autotransplants, but are those that have been used by the author. The first one is a piece of fascia that has been used to cover a wound. The second one is a piece of fascia that has been used to cover a wound. The third one is a piece of fascia that has been used to cover a wound. The fourth one is a piece of fascia that has been used to cover a wound. The fifth one is a piece of fascia that has been used to cover a wound. The sixth one is a piece of fascia that has been used to cover a wound. The seventh one is a piece of fascia that has been used to cover a wound. The eighth one is a piece of fascia that has been used to cover a wound. The ninth one is a piece of fascia that has been used to cover a wound. The tenth one is a piece of fascia that has been used to cover a wound. The eleventh one is a piece of fascia that has been used to cover a wound. The twelfth one is a piece of fascia that has been used to cover a wound. 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alive when the peritoneum was transplanted. Furthermore the applicability of peritoneal grafts is very limited and the sacrifice of large sections of peritoneum is certainly not harmless. Long narrow strips of peritoneum from the subcutaneous surface of the tibia are almost as readily obtainable as fascia. If however long wide sheets are required the deeper surfaces of the tibia must be exposed. This is objectionable because it requires considerable dissection. Should an infection of the wound occur the complication is far more disagreeable than an infection of the subcutaneous wound after the removal of fascia. Finally periosteum is not as plastic as fascia does not hold sutures as well and probably retains its structure for much shorter periods.

It is hardly necessary to direct attention to the importance inherent in the fact that the transplantation of fascia can invariably be autoplasmic, for the many advantages of autoplasmic over other types of transplantation — greatest probability of the transplant healing in place guarantee against transmission of infection etc — are now generally agreed upon.

#### THE CLINICAL AND EXPERIMENTAL USES OF FASCIA TRANSPLANTS

To obviate the impression that fascia is universally applicable as a transplantable material, attention was called to the fact that there are many purposes for which it is undesirable or inapplicable. The clinical and experimental uses to which fascia transplants have been subjected or for which they have been suggested will now be considered.

##### I. FASCIA TRANSPLANTS INTO ASEPTIC FIELDS

A critical analysis of all the results will not be attempted. This has been made by Kirschner, Kleinschmidt, and others and the advantages of transplantation of fascia over ordinary surgical measures for many affections have been pointed out. I shall take up certain applications in detail in the sections devoted to additional work in such fields. However a brief survey of all reported applications is desirable, as an index of what has already been accomplished. Fascia has

been employed either in the form of sheets or of strips.

*Sheets of fascia* have been used (1) to fill gaps at operations for hernia especially umbilical postoperative and recurrent. Very many satisfactory results have been obtained especially when the usual procedures might have been expected to fail because of very large defects poorly nourished cicatricial tissues etc. Up to the present time no failures have been recorded after the use of fascia. (2) For defects of the cranial dura. The procedure has been found remarkably satisfactory in more than 80 reported cases and has been demonstrated to be free from danger. The fascia heals in place without reaction and almost invariably makes a water tight closure. (3) For thoracic defects. The few recorded results have been excellent. The details will later be considered. (4) For wounds of solid organs. Large bleeding areas in the liver have been satisfactorily covered by fascia in several instances. It has been suggested for wounds of the spleen and kidney in the latter case the possibility of extravasation of urine would militate against its use. Fascia transplantations into wounds of the lungs as well as of the liver will be taken up later. (5) For isolation of nerves with the object of preventing fresh adhesions after nerves have been freed from beds of scar tissue. It has been shown however that adhesions between nerve and transplant may occur. (6) For reinforcement of blood vessel sutures and for occlusion of aneurisms. Experiments have demonstrated that sheets of fascia are strong enough to maintain stenosis of large arteries. Clinical experiences have not as yet been reported. (7) For defects of the diaphragm. Some experimental successes and failures have been reported. The question will be discussed later. (8) For interposition in ankylosed joints and for replacement of joint capsules. A few enthusiastic clinical reports have appeared but the advantages of the procedure over those ordinarily employed have not been clearly demonstrated.

*Strips of fascia* have been used (1) Most frequently to replace or to reinforce ligaments tendons or paralyzed muscles. Only a few

of the many satisfactory clinical applications need be mentioned. Defects of tendons have been replaced, the correction of certain paralytic deformities of the shoulder and foot of habitual dislocation of the patella and of the shoulder has been successfully practiced, fixation of the winged scapula has been accomplished, ocular ptosis has been corrected, etc. (2) To suspend the movable kidney in its corrected position to anchor the testicle in the scrotum in operations for cryptorchidism. It has been suggested for ptosed liver and spleen. Very few cases have been described. Not all were successful and one cannot as yet say that the procedure has been placed upon a sound basis. (3) For suture of fractured patella with the purpose of eliminating the use of foreign material. For the same reason, as well as for its great strength, sutures made of strips of fascia have been suggested for hernia operations. (4) To occlude the pylorus. Some satisfactory clinical result are reported, the operation having been based upon a number of experimental studies. I have shown elsewhere, however, that the experimental grounds for the operation are unsound. It was found that previous experiments had not covered sufficiently long postoperative periods. The conclusion I arrived at after more prolonged observation was that pyloric occlusion did not occur regularly after ligation with fascia strips and was almost invariably very brief and incomplete when it did follow.

## II. FASCIA TRANSPLANTS INTO AND ABOUT THE HOLLOW VISCERA

The very few efforts that have been made to transplant fascia in these regions are based chiefly upon the studies of Koenig and of Hohmeier. The former in a series of experiments carried out in 1911 reported that leakage did not occur after fascia reinforcement of weak suture lines in the incised oesophagus, stomach, intestine and bladder when leakage might have been ordinarily expected. Koenig applied the method in several operations upon the human being with results that were not always satisfactory. Nevertheless on the basis of his experiences Koenig advocated the use of fascia for such

purposes. Hohmeier in his experiments went one step further, he attempted to bridge complete defects of the bladder, oesophagus and trachea by fascia sheets. His work is the source of statements in the literature to the effect that fascia has been transferred successfully into such defects. The unsatisfactory outcome of Hohmeier's experiments especially in transplants into vesical defects will be subsequently indicated. Kostenko and Rubaschew, as well as Joffe demonstrated in a large series of experiments that it was in most instances essential to preserve the continuity of the mucous membrane of the hollow viscera in transplanting fascia over them. All these studies will be considered in greater detail. I wish to point out here that the only grounds for the rather generally held impression that the various hollow viscera have been successfully patched by fascia experimentally are the reports of very small tracheal and oesophageal defects that have been treated in this way. There is a single instance of successful fascia transplantation into a defect of a hollow organ in the human being. This is a case of tracheal fistula reported by Levit which will be described later. An unsuccessful attempt to bridge a urethral fistula by fascia comprises the only additional effort in this field.

On the other hand Koenig's results in the reinforcement of suture lines in the bladder led to similar successful attempts by other surgeons. These will be sketched very briefly. Schmid reports a vesicovaginal fistula operated upon several times without relief. He closed the opening in the bladder sutured over it a piece of fascia 2 x 3 centimeters and approximated the freed flaps of cicatricial vaginal mucous membrane. Smooth healing followed. In several instances Bumm succeeded in supporting large vaginal prolapses by implanting fascia sheets under the mucous membrane between the pubic bones. His report however was made shortly after the operations were performed and the final results are unknown. Henschen was the first to employ supporting strips of fascia in a case of rectal prolapse, the result was perfect despite some suppuration in the wound.

and partial exposure of the transplant. His method was successfully modified by Juracz and by Brun. From these reports conclusions entirely favorable to the practical use of fascia transplants about the hollow viscera would naturally follow. It should therefore be stated that sloughing and necrosis of the transplanted fascia occurred in all the reported cases other than those above mentioned — fascia rings about sacral anus after resection of the rectum (Enderlen, Kirschner) fascia over end to end suture after resection of intestine (Koenig) fascia over sutured urethra (von Hacker, Hohmeier, Koenig) and one case in the four fascia transplants reported by Bumm.

### III FASCIA TRANSPLANTS INTO INFECTED FIELDS

Closely related to the question discussed in the preceding section is that of fascia transplantation in the presence of infection. This aspect of the subject has received very scant attention. Yet an analysis of some of the reported experiments indicates that necrosis of fascia transplants need not necessarily occur when the field becomes accidentally infected. In fact several experimenters (Davis, Kornev, Hirano) noted this. Davis remarked that the transplanted fascia seems particularly resistant to infection for it retained its structure despite sloughing of the surrounding tissues. There are a few clinical reports of fascia having been deliberately transplanted in the presence of infection. Although no general conclusion can be drawn from this very small group of cases they are of interest in connection with the work to be reported and will therefore be given in detail.

*Kirschner.* Radical operation for vesical exstrophy. A defect 10 x 12 centimeters of the entire abdominal wall soiled by urine and feces remained. The sole closure of this infected gap was the transplanted fascia. The skin and subcutaneous tissues could not be entirely sutured over the transplant the latter being exposed over an area 4 x 10 centimeters. Despite these conditions necrosis of the fascia did not occur and a hernia did not develop. Death from pyelonephritis supervened 44 days after operation. At postmortem examination the transplanted fascia was firmly healed in place. Microscopically it was found normal in structure and staining characteristics.

*Rittershaus.* Operation for fecal fistula situated in a patch of granulation tissue and complicated by a very large ventral hernia. The fistula was excised but the infected layers of the abdominal wall could not be approximated. A large sheet of fascia lata was implanted in the defect its inner surface being in contact with the suture line in the intestine. There was slight discharge from the wound for a few days. It healed firmly however and the patient was well free from infiltration in the scar and from postoperative hernia when seen one and one half years later.

*Riese.* Operation for purulent sinus and hernia after appendectomy. There were many adhesions part of the cecum had to be resected. The whole field was infected. The peritoneum was sutured under tension. A sheet of fascia lata 10 x 15 centimeters was implanted to replace the defect in the abdominal wall that could not be closed. A small section from the edge of the transplant became necrotic and escaped from the wound the remainder healed in place. The final result was excellent a hernia did not develop.

*Schmid.* Fascia transplanted into a defect at operation for ventral hernia. An abscess developed in the wound sloughing of subcutaneous tissues and discharge of sutures followed but necrosis of the transplant did not ensue. The wound healed firmly.

*Jaffe.* Intestinal fistula and hernia following appendicitis. At operation the fistula was closed but the layers of the abdominal wall could not be approximated. A sheet of fascia 4 x 5 centimeters was taken from the anterior rectus sheath and implanted into the defect. Partial necrosis of the transplant followed. Nevertheless the wound healed solidly and a hernia did not appear.

An analysis of all these experimental and clinical observations leads to the conclusion that the success of fascia transplants over suture lines or in small defects of the hollow viscera, or into a frankly infected field can always be considered problematical and in the nature of a fortunate accident. It is therefore not surprising to find that writers consider fascia transplantation neither desirable nor indicated under such circumstances. The results I shall have to report are at absolute variance with those hitherto encountered. They urge I believe a complete revision of the subject. Despite these experimental results however the practical aspect of fascia transplantation into defects of hollow viscera (as well as into ordinary infected fields) remains largely a question of the future. At the present time the following viewpoint I believe is justifiable.



It is realized that necrosis of *fascia* transferred to the field in question may result in a deep seated phlegmon or a complicated fistula. Furthermore a serious complication perhaps a fatal one might follow if there occurred sloughing of or perforation through a transplant bridging a defect of one of the hollow viscera.

*A priori* therefore no matter how satisfactory the experiments to be detailed their application to the human being can be considered only when the usual surgical measures offer no promise of relief. Unfortunately this state of affairs exists in some of the difficult problems that are encountered problems too well known to be discussed here. It was in part as a suggestion for their solution that the studies in transplanting *fascia* into defects of hollow viscera were undertaken.

#### TECHNIQUE OF FASCIA TRANSPLANTATION INTO VISCERAL DEFECTS WITH SPECIAL REFERENCE TO THE HOLLOW ORGANS

No important new principle was employed in the method of *fascia* transplantation that I practiced. Defects were made as previous experimenters had made them the same *fascia* were transplanted the technique was in general the same. The only explanation that can be offered for the satisfactory results obtained in types of experiment found unsuccessful in the hands of others is to be found in the details of the technique employed.

The one significant difference was in the method of fixing the transplant at the defect. All previous experimenters sutured sheets of *fascia* over defects to the walls of the viscera beyond the cut margins. By this method they believed that the transplant would be best nourished from the cut edge of the organ and that it would offer the greatest resistance to tension and the least chances for leakage. In my early experiments this method was followed. It was found that leakage readily occurred between the surface of the organ and the adjoining surface of the transplant and that the resistance to tension was not great. Evidently a method was required that would prevent the cut margin of the organ from rolling back, would give sutures a firmer hold by being passed through all the layers of the

organ would invite the overgrowth of the lining mucous membrane of the hollow viscus and would most readily supply provisional nutrition to the transplant. These requirements were met by suturing fascial sheets into visceral defects. The results of the application of this method were remarkably satisfactory as will be seen in the various groups of experiments to be recorded.

The only additional differences in technique were in the method of suturing and of *hemostasis*. Concerning the latter previous experimenters took pains to clamp and ligate bleeding vessels at the margin of the defect made in the organ. Considerable devitalization was thus unavoidable, exactly where good nutrition was most desirable. By implanting *fascia* into the defect bleeding vessels could be readily caught in the fixating sutures and ligatures were not necessary. It was also to diminish devitalization that these sutures were not placed as close together as others had advised. Evidently as a result of the method of *hemostasis* and application of sutures and above all of the method of implanting *fascia* into and not over the defect the successful outcome of many of the experiments could be anticipated with absolute certainty.

Some details of technique will now be considered. Good operating room asepsis is essential and that it existed is demonstrated by the almost complete absence of wound infections throughout the various experimental groups. Dogs were the only animals used. The day before operation they were bathed and the skin epilated with barium sulphide paste well beyond the fields of the planned incisions. Either *anesthesia* was employed in all cases. After complete *anesthesia* the skin was thoroughly cleansed with soap and water, alcohol and 1:1000 bichloride solution.

The organ to be operated upon is exposed, drawn out of the wound (when feasible) and isolated by moist packings. Four points in the wall of the organ are marked by silk threads and the line of excision passes immediately beyond them. The distance between these points is not estimated but measured (with a sterilized steel tape). Leakage is prevented in operations on the

stomach and intestine by suitable clamps the contents beyond the clamps are sponged away as soon as the viscera are opened. After the desired excision of the walls of these organs has been made the cut margins usually evert promptly and the defect diminishes in size. This should not influence one to replace it by a smaller sheet of fascia for pronounced narrowing of the lumen of the intestine diminished capacity of the bladder etc. will naturally result. In fact it should be determined both by measurement and by guide sutures that the fascia removed for transplantation is slightly larger than the defect made in the organ.

Fascia from the abdominal wall is fairly satisfactory is conveniently obtained at abdominal operations and has been used in a small number of the experiments. Compared with fascia lata however it has a number of disadvantages which apply as well to the human being. It is not as strong as easily obtained as smooth or as large in uninterrupted extent, hernial protrusions followed in two instances when large sections were removed. Therefore fascia lata was employed invariably in all the later experiments. The section of fascia removed should conform closely in shape with the defect made in the organ. Great care is to be observed in its removal. The transplant should receive minimal handling. The lines of incision in the fascia lata should be clean cut. Portions of the deep surface should not be left behind. The transplant is of course quite useless if it has been perforated. The lowest and most dorsal part of the fascia lata is strongest and is therefore preferable in most instances.<sup>1</sup> After its shining superficial surface is laid bare two longitudinal incisions the desired distance apart are made down to the underlying muscle. The bridge of fascia between them is elevated by gentle blunt dissection. Its removal is completed by joining the ends of the two incisions either straight across or with a curve corresponding to the margin of the visceral defect to be replaced. Although the superficial as well as the deep surface of the fascia has been successfully used to face the lumen

of hollow organs it is preferable to turn inward the smoother (deep) surface of fascia lata. The fascia may be placed in warm saline solution before transferring it. This makes it somewhat succulent, however and not so easily handled. The best procedure is first to prepare the defect and then to implant the fascia directly into it.

Fine silk sutures were employed in all the experiments and were used on very thin half curved needles to avoid making large rents in the fascia. Black silk was used in many instances in order to outline clearly the situation of the transplant. The sheet of fascia is fixed into the defect at 4 points by sutures passed through it from within outward after having been passed through all the layers of the cut edge of the organ. These sutures are left long. Two on one side are drawn upon and a continuous suture made between them. This suture is passed from without inward through the fascia and in the opposite direction through all the layers at the cut edge of the organ. This method of passing the sutures is not essential however for satisfactory results have been obtained with other methods provided all the layers of the organ and the fascia as well were securely grasped. With any method of suturing the stitches are placed two or three millimeters apart, not so close as to devitalize the tissues nor so far apart as to permit gaping. The bite taken through the fascia should be slightly larger than that through the viscus and as each stitch is pulled taut the edge of the fascia is gently drawn upon on both sides of the suture to make it overlap slightly. Every third or fourth stitch is tied. The beginning and the end of the continuous sutures are tied to the fixation sutures. The second, third, and fourth continuous sutures complete the ring and make an uninterrupted suture line of very slightly overlapping fascia. It is important that the transplant should fit in place without fold or wrinkle. If the cut edge of the organ gapes between sutures additional ones are required from the margin of the fascia to points on the surface of the organ some distance from the primary suture line. Very few will be necessary if the size and shape of the transplant

<sup>1</sup>Early in the series the area of fascia lata above the external surface of the knee joint (the so-called "bursa") was found to be the most suitable.

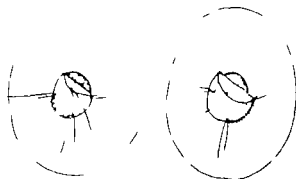


Fig. Diagrams illustrating the previously employed method of filling the transplanted fascia over the defect (on the right) and the method of suturing the transplant into the defect practiced in the experiment and to be described.

are correct and the primary tier of sutures is accurately placed. A complete secondary tier was used in only a very few experiments.

A fluid diet for several days is given after operations on the alimentary tract. This diet is continued for a week or more after operations on the oesophagus. It is then followed by semi-solid nourishment. Neither a permanent catheter nor the administration of drugs was found necessary after operations on the bladder or ureter.

#### I FASCIA TRANSPLANTS INTO DEFECTS OF THE BLADDER

These experiments are described first and will be taken up in greater detail than any of the subsequent ones because the results obtained have been so striking. The largest number of experiments were performed in this group yet the outcome of every operation was successful even when as much as one-half approximately of the bladder wall was replaced by fascia. Apart from the absence of contractility of the filled defect the functional results were perfect in fact resistance to hydrostatic pressure was found to be greatest at and about the newly formed bladder wall. It is of interest to note that vesical calculi never developed when fascia was employed to replace the defect but were present around fat transplants used for this purpose. A remarkable feature of these experiments was the development of macroscopic plaques of true bone at the site of

transplantation. This began astonishingly soon after operation and reached its height in about two months. Relatively little significance would have been placed upon the formation of osseous tissue were it not for the fact that it developed invariably in all the experiments. Not only bone but also cartilage and bone marrow appeared as well as an ensheathing tissue akin to periosteum. These observations will be detailed. It may be stated here that from the practical side the development of bone did not in any way interfere with the functional result. On the contrary this was probably enhanced by the increased strength of the newly formed bladder wall. The latter term is used advisedly for as will be seen the results do not depend upon healing by shrinkage of the defect but upon the replacement of the defect by new tissue. Another feature of considerable interest was the extension of smooth muscle fibers from the margin of the bladder wall across the site of the defect.

Before detailing the experiments the previous work done in this field should be reviewed. It has already been said that the statements one finds in the literature are erroneous in referring to appreciable vesical defects having been replaced successfully by fascia transplants. They are based on studies by Hohmeier and by Kostenko and Rubaschew. Upon analysis of Hohmeier's experimental work it is found that the results were quite unsatisfactory. Four experiments were performed upon fascia implantation into bladder defects. In one a peritonitis from unknown cause resulted in death a few days after operation. Perforations through the transplants occurred six and nine weeks after operation in two succeeding experiments. It was only in the fourth that the fascia appeared firmly healed in place. In this instance death resulted from distemper three weeks after operation. The period of observation is evidently not sufficiently long to suggest any definite conclusion especially in view of the other experiences. Kostenko and Rubaschew<sup>1</sup> found that fascia transplants occasionally prevented leakage from

<sup>1</sup>The original published in the *Abstracts of the Zts. f. Chir.* and in papers by Kurnow and Hart.

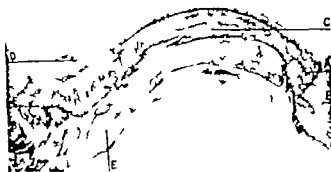


Fig. 2. Pathology No. 3368. Two days after fascia transplant into defect of bladder. A. The two layers of fascia attached firmly to bladder wall at B. B. C layer of fibrin. D. leucocytes on free surface. E. adherent omentum.

the bladder when implanted into very small defects (defects less than 2 x 2 centimeters how much less is not stated). The periods of time after operation at which the observations were made are not given. Healing in these occasional instances depended upon shrinkage of the defect and approximation of the cut edges of the bladder wall. In general these experimenters agreed with Joffe who demonstrated that fascia often prevented leakage when implanted over vesical defects after the mucous membrane had been sutured but that necrosis of the transplant and perforation followed uniformly when the lips of mucous membrane were not approximated.

On the other hand the experiments of Koenig, Hohmeier and the others above mentioned demonstrated that fascia affords a strong barrier against leakage when transplanted over suture lines in the bladder.



Fig. 3. Pathology No. 3368. Enlargement at I in Fig. 2 showing details of repair. I. The two layers of fascia undergoing degeneration. B. thick layer of fibrin sealing the chink between transplant and bladder wall. C. layer of fibrin to which the omentum is adherent. D. silk suture.

The procedure has been successfully employed in the human being by Koenig and by Kostenko and Rubaschew.

Eighteen experiments were made upon fascia transplantations into vesical defects. There were four fatalities, only one in which approximately five eighths of the bladder was replaced by fascia, being due to necrosis of the transplant and perforation. The other three followed infection or rupture of the abdominal wound. The defects made in the bladder varied in size from 2 x 2 centimeters to about one half of the bladder wall.<sup>1</sup> The

<sup>1</sup> In the description of experiment the measurement of the defects is given rather than the relation to the size of the bladder. The latter varies too greatly with the amount of contracted tissue to be accurate.

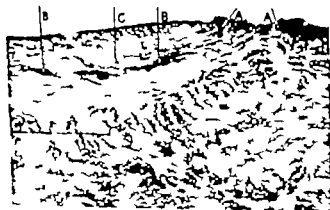


Fig. 4. Pathology No. 3367. Six days after fascia transplant into vesical defect. I. Deposits of lime salts on the surface. A. B. in the depths. C. C. fascia under layer of hyaline degeneration.



Fig. 5. Pathology No. 3403. Seventeen days after fascia transplant into defect of bladder. I. Loose tissue. B. loose tissue. C. loosely woven connective tissue occupying defect. D. D. strand of smooth muscle in defect. I. I. fragments of epithelium on surface.



Fig. 1. Histology. N. 3. S. S. I. b. a.  
k. t. f. h. t. j. l. a. t. t. f. f. l. a. t. t. b.  
f. t. l. u. n. B. B. t. n. u. t. l. e. f. t. l.  
C. C. b. o. m. a. r. r. o. D. t. t. l. a. t. f. t. l.  
f. t. l. C. m. t. l.



Fig. 1. Histology. N. 3. S. S. I. b. a.  
k. t. f. h. t. j. l. a. t. t. f. f. l. a. t. t. b.  
f. t. l. u. n. B. B. t. n. u. t. l. e. f. t. l.  
C. C. b. o. m. a. r. r. o. D. t. t. l. a. t. f. t. l.  
f. t. l. C. m. t. l.

specimen were examined from two days to five months after operation. The following are a considerable proportion of the experi-

ment chronologically arranged and chosen to illustrate various findings.

EXPERIMENT D. Small. Operation.

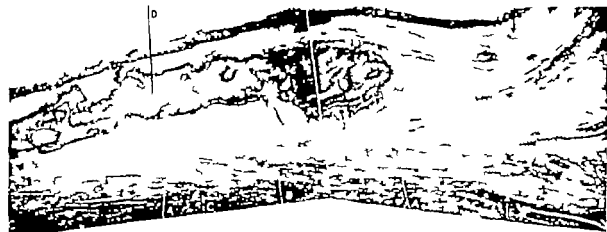


Fig. 1. Histology. N. 3. S. S. I. b. a.  
k. t. f. h. t. j. l. a. t. t. f. f. l. a. t. t. b.  
f. t. l. u. n. B. B. t. n. u. t. l. e. f. t. l.  
C. C. b. o. m. a. r. r. o. D. t. t. l. a. t. f. t. l.  
f. t. l. C. m. t. l.



Fig. 9 Pathology No. 3843 Ten weeks after fascial replacement of large quadrilateral defect of bladder. To the right is the moderately distended unopened bladder. The adherent omentum outlining the size and shape of the defect. To the left is the half of the bladder which has been operated on showing the type of mucous membrane over the defect.

tion March 9, 1915. Right hypogastric incision. Bladder moderately full. Isolated from abdominal cavity by moist packings. A circular section from its vertex  $2\frac{1}{2} \times 2$  centimeters removed. Considerable oozing from cut wall; no ligatures applied. Sheet of fascia lata from upper thinner area of appropriate size and shape removed and sutured into defect with black silk. When suture was complete the defect was bridged by fascia, measured  $2\frac{1}{2} \times 1\frac{1}{2}$  centimeters. Reinforcing sutures not used; the primary tier making snug approximation. Layer sutures of the abdominal incision.

**Postoperative course.** Temperature 102 the day after operation. Wide separation of the wound. Death March 11, two days after operation.

**Postmortem examination.** Very extensive cellulitis, numerous pockets of pus in all the layers of the abdominal wall. No peritonitis. Anterior surface of bladder with a small part of the transplant adherent to parietal peritoneum in the immediate vicinity of the abdominal wall infection. The peritoneum is here deeply congested, discolored, shaggy; evidently the infection would soon have invaded the peritoneal cavity.

Congested tongue of omentum firmly adherent at site of fascial transplant. Bladder distended with cloudy urine (containing many pus and red cells); no sign of leakage. Bladder removed and subjected to great hydrostatic pressure; absolutely no leakage. External surface of the transplant not seen (omentum adherent). Viewed from within the silk sutures outlining transplant showed that defect had not shrunk. Submucous hemorrhages in bladder wall near cut margin. Many fine shreds hang from transplant; no concretions about them.

**Microscopic examination.** Surgical Pathology No. 3368. The fascial transplant is in part broken up and undergoing hyaline degeneration. In some places only a few remnants are seen. The surface facing the lumen (to be termed the free surface in all further descriptions) is occupied by numerous



Fig. 10 Pathology No. 3843 Ten weeks after fascial transplant into visceral defect. Showing shading of bone (B) into connective tissue (C) and of this into an adjoining peritoneum like liver tissue (C C C C).

leucocytes, some of which are found among the fascial bundles. The opposite surface of the transplant is covered by a thick layer of fibrin to which the omentum, rich in blood vessels, is adherent. Silk sutures at the surface mark the line of demarcation between bladder wall and transplant. All the layers of the bladder wall stop sharply at the edge of the defect. They are united to the transplant by a very thick layer of fibrin. There are very many blood vessels (filled with red blood cells) near the cut margin of the bladder wall.

EXPERIMENT DOG 210 Large male Operative



Fig. 11 Pathology No. 3843 Ten and one-half months after fascial transplant into defect of bladder. Showing bone extending to the extreme margin of the defect and very active changes in the osseous tissue. (B) Site of transition from bladder wall to tissues of the defect. (B) Large vascular marrow space in which osteoclasts are seen.

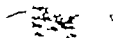


Fig. 1. Bladder, N. 149. Transplanted into the half of the bladder. The defect of the bladder is closed by the large mass of the bladder.

here the peritoneum is the same as in the bladder.

Bladder tensely distended with urine. N. 149. The bladder is large. Both external and internal surfaces of bladder much congested, more so toward the right. There are several small, brownish, hemorrhagic, rather highly thin, layers of tissue, appears to overlie the inner surface of the transplant. The relation not determined. The bladder preserved for microscopic examination.

Fig. 2. Bladder, N. 149. The transplant has undergone considerable degeneration, being scarcely recognizable in several places. Its free surface is covered by a layer of young, thin, highly blue. The bladder is placed into the depths of the transplant. A layer of young



Fig. 5. Bladder, N. 150. 16 months after transplant. The defect of the bladder has grown thick vascular of connective tissue on the place.



Fig. 16. Pathology No 3844. Three months after fascia transplant into a bladder defect. To the right is the unopened empty bladder the site of the defect being between the dotted lines. To the left is the interior view showing the bone plaque at the center.

connective tissue containing many round cells occupies the deep surface of the transplant to thus the highly vascular omentum is adherent. The ends of the strip of fascia merge almost insensibly into the adjoining bladder wall only the silk sutures definitely mark the boundary.

**EXPERIMENT DOG 247.** Medium sized male. Operation March 19 1915. Curved hypogastric incision. Bladder almost empty. Defect of antero-superior wall  $3 \times 2$  centimeters. Moderate bleeding from cut edge. Thicker part of fascia lata  $3 \frac{1}{2} \times 2 \frac{1}{2}$  centimeters sutured into defect with black silk. A few reinforcing sutures required. Actual defect bridged then measured  $3 \times 2$  centimeters. Layer surface of wound.

**Postoperative course.** Wound separated soon after operation some purulent discharge at first then showed tendency to heal but never closed. Death from large hemorrhage from wound on April 5, seventeen days after operation.

**Postmortem examination.** Tissues very pale. Source of hemorrhage probably the epigastric vessels. Bladder greatly distended with urine no bulging at site of transplant. Latter outlined by black silk suture unless they have migrated no shrinkage as determined by measurement. Thin layer of bluish omentum adherent to part of transplant. Part of fascia visible is smooth and glistening. Bladder adjoining transplant faintly purple in color. Internal appearance of transplanted area is that of a clean smooth flat healing ulcer. Few old submucous hemorrhages near edge of defect. Newly formed tissue about transplant is of same thickness as bladder wall.

**Microscopic examination.** Surgical Pathology No 3403. The fascia transplant is not recognizable as such. A loosely woven fluid like connective tissue occupies site. In this tissue near (in some sections directly at) the free surface are small masses of bone. The latter is laid down about cells in the typical trabeculated framework shading off into osteal tissue by insensible gradations. In most of the solid only deposits of lime are present



Fig. 17. Pathology No 3844. Three months after fascia transplant into bladder defect. 1. Preponderance of osteodrats B B B. B layer of ensheathing periosteal like connective tissue.

in situations identical with the bone deposits. The fusion between the bladder wall and the tissue filling the defect is complete. Beneath the above described loosely woven layer of tissue, smooth muscle bundles are seen here and there. They are found to be continuous with the muscle wall of the bladder at the edge of the defect. The omentum is intimately attached to a layer of connective tissue beyond the muscle bundles in the defect. Fragments of bladder epithelium are seen here and there on the free surface of the transplant. Presumably they represent epithelial overgrowth from the margin of the defect however a continuous layer of epithelium was not found in any of the sections.

**EXPERIMENT DOG 242.** Rather large male. Operation March 25 1914. Incision in right hypogastrium. Bladder distended. Points marked at such distances that removal immediately beyond them would be an excision of about half the bladder wall. Defect measured  $4 \times 5$  centimeters extending close to the insertion of the left ureter. Fascia from abdominal wall slightly larger than this sutured into defect with white silk. Gap in abdominal fascia partly sutured. Suture of wound.

**Postoperative course.** Two weeks after operation tympanic hernial protrusion of abdominal wall at site of fascia excision. This persisted to the end. No urinary symptoms noted. Development of distemper for which animal was chloroformed April 27 thirty three days after operation.

**Postmortem examination.** Typical evidences of distemper in examination of the respiratory system.

Fairly broad adhesions of omentum to empty bladder at site of transplant. Vesical serosa deeply congested in region of operation. Measurement between sutures faintly seen when interior of bladder was inspected showed slight contraction. Mucous membrane appeared to have grown over the defect down to an area  $1 \times 1$  centimeters. This area was occupied by a firm whitish smooth





Fig. 1. Histology of bladder showing tumor formation after transplantation of bladder cancer cells.

Fig. 2. Histology of bladder showing tumor formation 36 months after transplantation of bladder cancer cells.

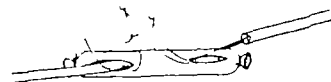


Fig. 2 Diagram illustrating the method of fixing the ends of a resected ureter into a previously made tube of fascia. On the right the ureter is being drawn through a slit in the tube; on the left the wall of the ureter is being fixed to the tube at the slit. (The slits are disproportionately large.)



Fig. 24 Exterior views at sites of esophageal defects replaced by fascia. The tubes are distended with varying amounts of fluid. On top sixteen days after operation; in the middle twenty-three days after operation; at bottom one month after operation.

by a thin layer of dense connective tissue analogous to periosteum. Beyond this is a broad zone of dense poorly staining connective tissue (scar tissue) in which are seen muscle bundles continuous with those of the bladder wall at the defect. The tissue occupying the defect merges insensibly with the bladder wall. Silk sutures identify the approximate position of the defect; it is evident that little if any shrinkage has taken place.

EXPERIMENT DOG 28, Large female. Operation April 6, 1915. Transverse hypogastric incision through fascia, muscles and peritoneum split

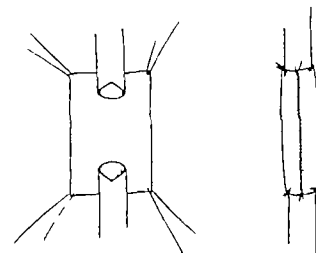


Fig. 3 Diagram to show the method of constructing a fixation tube between the ends of a resected ureter.

The mass of bone is hollowed out into spaces occupied by a loosely woven tissue rich in cells and in blood vessels, a tissue analogous to young bone marrow. The free surface of the bone plaque is covered by a layer of epithelium continuous with the bladder epithelium. The deep surface is covered

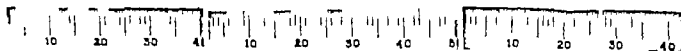


Fig. 25 Distance of interior at sites of esophageal defects replaced by fascia. (At left) On month after operation. (In middle) twenty-three days after operation. (At right) fifteen days after operation.



Fig. 5. Tailology N 354. Sixteen days after transplantation of esophageal defect. A line of transition from esophageal to bladder tissue of the defect to the left. B muscle layer of esophagus extending to defect. C connective tissue of bladder granulation tissue. D connective tissue of bladder granulation tissue. E fold of the transitional epithelium near defect.

Longitudinally. Bladder moderately distended. P. marked so that all ulcers are at junctions. A little slightly larger than the tumor. Lett. black. B. little in view of sutures. Three. C. at ches. E. at junctions. Small. H. at junctions. A. all of bladder touched.

P. slope. A. ntful. Slight. A. ge. A. m. d. bl. ro. form. l. fu. nd. l. i. s. s. after operation.

P. i. r. t. Bladder. t. r. i. v. l. full. L. e. t. r. s. i. n. t. r. e. c. t. A. d. r. a. t. o. m. t. l. t. h. e. s. e. l. l. e. f. o. p. e. r. t. a. B. l. f. r. e. o. p. n. g. b. l. a. d. d. e. r. n. s. u. r. e.



Fig. 5. Tailology N 355. One month after transplantation of esophageal defect. A line of transition. B mm closure of esophagus extending to the defect. C here is lost dense connective tissue. D connective tissue of epithelium.

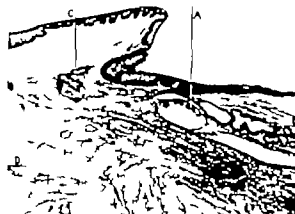


Fig. 5. Tailology N 354. Tent three days after transplantation of esophageal defect. A line of transition from esophageal to bladder tissue of the defect. B muscle layer of esophagus extending to defect. C mucous gland. D defect. E line of esophagus. D degenerating fat.

me. It was made of the solid tissue occupying region of transplant pale and different from the remainder of the bladder. It was 4 x 3 cm. It was little if any shrinkage. This is corroborated by inspection of the interior when the black ink through the approximated edges of the small size of the defect. A layer of translucent pinkish jelly like tissue carrying members of the fine blood vessel is spread on the posterior of the transplant. Visible through it is pinkish gray very solid plaque of tissue. It is at the point with needle it is found bone like in consistency. The bladder is as thick as the normal.

Microscopic. Serial Tailology N 3518. A large remarkably well formed mass of bone occupies most of the free surface of the defect. A typical osteoblasts as well as a number of osteoclasts are seen. Narrow spaces are frequent. Generally small. One end of the bone plaque is fairly smooth and rounded. The opposite end presents a regular spreading prongs. Filling the space between them and the intimate fusion of a large mass of cartilage (is blue microscopically as small blue speck). On one side the cartilage cells are intermingled with the bone cells. At the extreme the broad zone of typical cartilage merges gradually into a well layer of connective tissue. A thin perichondrium. In addition to this large deposit of cartilage there are several small islands of cartilage cells scattered throughout the bone plaque. The free surface of the bone plaque is covered completely by epithelium. It is not unlike the normal bladder epithelium. Adjacent to its deep surface is a well formed layer of connective tissue. In its appearance with perosteum. Beyond this is a thin continuous layer of typical smooth muscle typical in its color. The stain in the construction of the cells in the elongated

gated narrow nuclei. Its continuity with the smooth muscle layer of the bladder wall can be easily distinguished. Outside the muscle layer there is an abscess, the wall of which brings out the contrast with the smooth muscle. The omentum was adherent to its external surface.

**EXPERIMENT DOG 41** Male of average size. Operation, December 1, 1915. Transverse incision. Bladder enormously distended. After puncture a quadrilateral strip from vertex, anterior and posterior walls  $5 \times 2\frac{1}{2}$  centimeters, was removed. Six fixation sutures for the fascia transplant were necessary instead of the usual four (see section on Technique). At two points reinforcing stitches were required over the primary tier. Layer suture of abdominal incision.

**Postoperative course** Uneventful. Animal sacrificed with chloroform February 8, ten weeks after operation.

**Postmortem examination** Broad omental adhesion at site of operation. Bladder wall under omentum seen to be more opaque, less pink than the rest of bladder yet smooth and shining. No bulging here with water distention. Inspected from within mucous membrane apparently covers tissue filling defect except in one small area into which a few black sutures protrude. At this point the bladder wall appears thinner. Mucosa at defect more corrugated thicker(?) pinker than over remainder of bladder. Firm shotty nodules felt underneath.

**Microscopic examination** Surgical Pathology No. 3843. The free surface of the tissue filling the defect consists of small papillae or rugae covered with an unusually thick layer of epithelium continuous with the bladder epithelium. The stroma of these papillae is rich in blood vessels and small round cells. A thick layer of dense connective tissue occupies most of the remainder of the defect. Between it and the villus like layer is a small area of bone. This shades off gradually into osteoid tissue which in turn merges with a layer of perosteum like connective tissue. An irregularly distributed layer of smooth muscle bridges the defect lying for the most part in the deeper surface of the connective tissue.

**EXPERIMENT DOG 35** Operation November 24, 1915. Transverse incision. Quadrilateral defect  $4 \times 3$  centimeters in the intersuperior part of bladder replaced by fascial sheet  $4\frac{1}{2} \times 3\frac{1}{2}$  centimeters. In this experiment the vessels in the bladder wall were unusually large and three were ligated a short distance from the edge of the defect. Four reinforcing stitches at necessary points over the primary continuous suture.

**Postoperative course** Nothing unusual. Animal chloroformed February 8, 1916, two and a half months after operation.

**Postmortem examination** Omentum adherent to bladder over a very firm plaque of tissue occupying site of defect. This tissue approximates closely the size of the original defect, is differentiated from the remainder of bladder wall by its less pink color and

its border is well outlined by the black silk sutures. Inspection of the interior discloses mucous membrane covering the region of the transplant except at one place where a silk suture hangs free.

**Microscopic examination** Surgical Pathology No. 3842. The fairly large plaque of bone that formed near the surface of the defect shows great activity. Many osteoblasts and osteoclasts are seen the bone mass being laid down in very irregular grotesque forms. Epithelium is continuous over the site of the defect even where the bone is prolonged into pointed projections. The connective tissue layer ensheathing the deep surface of the bone plaque is closely analogous to periosteum. The layer of smooth muscle bridging the site of the defect is not as readily distinguishable as in previous specimens yet can be seen in the dense connective tissue occupying most of the defect beyond the bone.

**EXPERIMENT DOG 31** Operation, November 17, 1915. Transverse incision. Defect in bladder accidentally made somewhat larger than fascia lata removed to fill it. Fascia measured  $3\frac{1}{2} \times 2\frac{1}{2}$  centimeters and was sutured in place under considerable tension. Reinforcing sutures were desirable could not be placed without narrowing the defect therefore were not employed. Unusual oozing from cut edge of bladder and of abdominal incision noted at operation.

**Postoperative course** Uneventful convalescence. Normal course until January 29 when stools became tarry. Fresh active bleeding from the bowel followed and the dog succumbed on January 31, two and a half months after operation.

**Postmortem examination** Tissues very anemic. Stomach and intestines filled with old and fresh blood. Source of the hemorrhage was not found. Peritoneal cavity negative. Omentum broadly adherent at site of operation on the bladder. Latter greatly distended. Silk sutures outlined a circular area approximately the size of the original defect. Peritoneal surface of tissue filling defect not visible through omentum. Viewed from interior a smooth bony plaque about  $2 \times 2$  centimeters is seen occupying the center of the transplanted area covered by a thin translucent layer of tissue continuous with the mucous membrane.

**Microscopic examination** Surgical Pathology No. 3841. The marrow spaces that are present in the plaque of bone which had formed are easily seen with the naked eye. Microscopically very large blood vessels as well as numerous small ones are found in the loose meshed tissue of these spaces. The elongated mass of bone occupies most of the free surface of the original defect is covered by a continuous layer of epithelium and ensheathed by a connective tissue layer remarkably like periosteum. This is the only specimen which showed a second independent deposit of bone in the depths of the connective tissue occupying the defect. Smooth muscle spreads in a thin layer across the defect as in the previous experiments.

**EXPERIMENT DOG 115** Large male. Opera-

the experiments I wish to dwell upon two remarkable developments noted in the processes of tissue repair bone formation in the defect and smooth muscle growth across the defect

It is out of place to enter here into the whole question of the tissues required for bone development That previous bone or periosteum is not necessary for the formation of new osseous tissue was of course demonstrated by finding such tissue developed in situations far removed from the skeletal system The experiments I have reported show clearly that the bone deposits occurred with concentrations of lime as their beginnings without any relation to blood vessels or to any of the tissues of the adjoining bladder wall Except for the necessary nourishment to the tissues repairing the venal defect it might almost be said that the development of bone took place in this situation outside the body This is further emphasized by the fact that the deposit of bone was invariably limited to the site of the defect The suggested possibility that fascia genetically related to bone was transformed into that tissue is manifestly invalidated by the fact that lime deposits and bone formation appeared when fat was transplanted Furthermore it is to be noted that the fascia degenerates at an early stage before the bone development is well on its way

The evolution of bone in these experiments can be explained therefore only by the metaplasia of any connective tissue occupying the defect That it was a development that may in a sense be termed normal for the existing conditions is shown by its presence in every experiment The reasons for and the way in which bone is laid down appear to me to be as follows The tissue occupying the defect is constantly being subjected to great tension The defect being too large to permit obliteration reinforcement for the tissues filling the gap is desirable A favorable opportunity to obtain reinforcement exists potentially in the presence of calcium salts in solution in the urine These are laid down on the surface and are taken up in the depths of the transplant by imbibition The lime deposits stimulate the surrounding connective tissue chemically or physically (or chemico

physically) to build up the most powerful barrier Bone deposits are the result with lime salts as their actual nuclei or their centers of stimulation It is in this way that the microscopic findings in the experiments are best understood Furthermore one can realize why the astonishingly early development of bone was not a degenerative phenomenon

The periosteum like hyal encasing the bone plaques can be accounted for metaplasia on the theory of metaplasia of adjoining connective tissue and similarly metaplastic changes in connective tissue included between bone trabeculae will explain the development of bone marrow However the appearance of cartilage in one experiment cannot be accounted for readily in this way The fact that cartilage developed only once appears to require in itself a different hypothesis It is true that the appearance of the large deposit of cartilage situated in a cup like hollow in the bone may be ascribed to metaplasia of connective tissue filling the cavity The suggestion is evidently forced however for hollows in the other specimens of bone do not reveal cartilage Furthermore it cannot account for the scattering of the cartilage cells in the adjacent bony mass and above all for the scattering of islands of cartilage cells at widely separated points throughout the bone plaque An adequate explanation cannot be offered There appear to be only two possibilities either bone was converted into cartilage or cartilage into bone The latter would of course be in accord with a widely held view but is not quite adaptable to the findings Cartilage was not laid down in any of the other experiments and in this specimen does not present the picture seen when cartilage is being replaced by bone In support of the opposite hypothesis it might be urged that in the specimen in question the sharp projecting prongs of bone at the end of the plaque made friction with the adjoining bladder wall in an effort to overcome this the development of cartilage was in the nature of a closely related tissue adaptation of the active growth of bone Even if this were true however it does not account for the islands of cartilage scattered in the bone The best suggestion that can be offered

at the present time is that in this experiment cartilage was originally laid down, as in the embryo and that it was gradually replaced by bone as in postnatal life

The presence of muscle bridging the defects will now be considered. I believe that the specimens offer conclusive evidence of the regeneration of smooth muscle. This question has been discussed for many years. The presentation of arguments based on the work that has been done in the past would lead too far afield. It will suffice to say that the generally held view at the present time is that smooth muscle regenerates little or not at all.

The large defects that were made in the bladder offered an unusual opportunity to investigate the question anew. The tissue found in the defects was undoubtedly smooth muscle.<sup>1</sup> It was characteristic in staining qualities in the shapes and arrangement of the cells in the long narrow nuclei and was continuous with the smooth muscle of the bladder wall on either side of the defect. The development of the smooth muscle in the defect can be traced in the chronological arrangement of the experiments. In examinations soon after operation practically the whole muscle wall stopped abruptly at the margin only a few fibers extending short distances into the defect. At later stages bundles of muscle extended well into the defect to make a neat thin continuous layer of muscle or an irregular ill defined layer of interlacing bundles in the latest stages. It is certain that the defects contracted little if at all and that strips of muscle were not left attached when the defects were made. Only by the development of new muscle bundles can the layer of smooth muscle found across the defect be explained. Evidences of smooth muscle regeneration were seen after defects made in some of the other hollow viscera but because they were inconclusive no further reference need be made to them.

## 2. TRANSPLANTATION OF FASCIA INTO URETHRAL DEFECTS

The experimental work of Kostenko and Rubschew indicates that fascia transplan-

tion over suture lines in the ureter is not a reliable procedure for leakage of urine followed in several instances. In one experiment however at which an end to end anastomosis of the divided ureter was made and surrounded by a cuff of fascia it was found that the suture lines in the ureter had separated and that the fascia was the only barrier to successfully prevent the escape of urine. Clinically however a case was reported by these authors in which fascia placed over the sutured ureter (after removal of a calculus) did not prevent leakage.

The clinical problem of replacement of ureteral defects has not been solved. Nephrectomy must be performed if end to end suture is impossible and the upper end of the divided ureter cannot be implanted into the bladder. It is therefore surprising to find that so few experimental efforts have been made in this field. Owing to the resistant qualities of fascia I believe that tubes made of this material might satisfactorily replace ureteral defects. Although there is not a single completely successful experiment to support the view that the procedure is practicable and possibly clinically applicable it is nevertheless maintained for the failures encountered depended on several factors that can be eliminated: (1) The ureters in the dog are of very small caliber (2) faulty technique (3) inability to obliterate permanently the dead space left after extraperitoneal exposure of the ureter. Additional experience may obviate these difficulties.

The best experimental results were obtained when a tube of fascia was first constructed around a glass rod in the thigh and was transferred to the ureteral defect two weeks later. In three experiments in which this was done there was absolutely no leakage. Unfortunately the animals died too soon after operation (one from hemorrhage two from unknown causes) to determine if a permanently satisfactory result would have been obtained. The description of a single experiment will suffice to illustrate the technique.

EXPERIMENT DOG 342 Male, medium size  
First operation June 10 1914. Fascia lata exposed in left thigh. Glass rod smooth at both ends

<sup>1</sup> Drs. Clark McWhorter and J. Sharp of the Colorado University College of Physicians and Surgeons kindly corroborated this statement.

approximately the diameter of the ureter dipped in vaseline placed over fascia. Latter incised on either side of rod sutured snugly over it with very fine silk. Subcutaneous tissue and skin sutured.

**Second peristalsis** June 25. Left ureter exposed extraperitoneally by an incision through the lateral abdominal musculature. Middle part of ureter isolated the vessel running alongside ligated above and below. Centimeters resected. Field of first operation exposed. Clean rod found loose and removed. Fascia tube made complete by freeing both ends and ligating them. The tube then measured 7 centimeters. Small slits were cut into it at each end near the ligatures. The ends of the ureters were drawn through the slits and fastened within the tube as seen in the accompanying diagram. Layer suture of the wound.

**Postoperative course** Nothing abnormal noted. Four days after operation the dog was found dead in his cage.

**Post mortem** Cause of death could not be ascertained. Wound solid no leakage of urine. Peritoneal cavity intact. Kidneys negative. Ends of ureters firmly fixed in fascial tube. Probe passed readily from above through ureter into the tube and the lower end of the ureter. Water injected from above passed through without difficulty.

The results of all the experiments in which the fascial tube was built around the ureteral defect were unqualified failures. Death either from leakage and infection or from hemorrhage into the wound. In one instance the hemorrhage was only moderate and the anatomical result of the operation was satisfactory. This experiment will be reported and the technique of construction of a fascial tube *in situ* will be described.

**EXPERIMENT DOG 266** Operation April 1914. Extraperitoneal exposure of middle portion of the left ureter. Isolated 2.5 centimeters excised. Vessel accompanying ureter not ligated to avoid compromising the lumen. Anterior lips of cut ends of ureter slit up a few millimeters. Sheet of fascia lata of suitable size held by tension sutures placed under the defect. Posterior lips of ureter ends fixed to fascia at two points each by passing double threaded sutures and tying knots on outside of fascia. The upper pair of guide sutures in the fascia brought together then the lower pair. The two edges of the fascia then sutured (continuous fine silk) to make the tube. Before latter was complete above and below double threaded sutures were passed from interior lips of ureter ends through fascia knots on the outside. The sutures were so placed that when drawn taut and knotted the cut ends of the ureter would be held wide open. The fascia tube suture completed above and below by being carried over ureter and sutured to its

all. Additional stitches all around from end of fascia tube to ureter wall fixed the tube firmly in place. Layer suture of the wound.

**Postoperative course** Condition good immediately after operation. Gradually deteriorated. Death April 14.

**Postmortem** Moderate hemorrhage into the extraperitoneal space. Source apparently the vessel accompanying ureter. No blood in the urine filled bladder. Anastomosis intact. Probe and fluid pass through readily from above downwards. Viewed from within the lips of the ureter fit snugly against fascia tube.

### 3. FASCIA TRANSPLANTATION INTO CESOPHAGEAL DEFECTS

Brief reference has already been made to the experiments performed by Koenig and by Hohmeier in reinforcing suture lines of the esophagus. Kostenko and Rubaschew reviewed their work in a considerable number of experiments. They found that the transplant could be depended upon almost invariably to prevent leakage from such suture lines. On the other hand necrosis and perforation of the fascia followed all their attempts to replace appreciable defects—2 x 2 centimeters or more—of all the layers of the organ.<sup>1</sup> There were occasional successes in their efforts to bridge very small esophageal fistulae by fascia transplants; they were found to depend upon obliteration of the defect and not upon upbuilding of new tissue in it. All these observations have no further practical significance than to suggest that suture lines in the esophagus can be reinforced satisfactorily by fixing fascia strips over them. In short it was as incorrect to say that experimental defects of the esophagus have been satisfactorily bridged by fascia as it was to make such statements concerning vesical defects.

Despite these experiences it was thought that with the modifications of technique that have been described large defects might be successfully replaced by fascia transplants. It was essential however that little or no esophageal stenosis should follow otherwise the procedure would be no better than desirable in fact than ordinary suture or plastic methods. Only a few experiments were necessary to demonstrate that large defects

<sup>1</sup> In other experiments not reported as of these experiments.

involving as much as the entire anterior aspect of the esophagus could be satisfactorily bridged in this way. The results were good anatomically and functionally. Slight stenosis was observed in an experiment concluded two weeks after operation; this was less evident in an experiment ended three weeks after operation and was almost imperceptible four weeks after operation. In view of the more infected state of the animal esophagus, the unavoidable movements of the head and neck after operation and the necessary administration of nourishment by mouth soon after operation, it appears correct to believe that the expectation of success after fascial transplants into esophageal defects in the human subject can be even greater than in the experiment. The present-day treatment of small esophageal fistulae is simple and efficient. The attempt to close larger defects (as after excision of a diverticulum sloughing from impacted foreign body, etc.) involves complicated plastic procedures, the average results of which cannot be termed very satisfactory. It remains for the future to determine if fascia transplantation technically very simple can offer better results.

The experimental results I have obtained are seen in the descriptions that follow. Granulation tissue appeared on the surface of the transplant soon after operation. In the later stages the defect was found solidly filled by connective tissue (representing the altered fascia), partly contracted and entirely covered by epithelial overgrowth.

**EXPERIMENT DOG 157.** Female, medium size. Operation, March 1, 1916. Longitudinal incision slightly to left of midline of neck. Musculature split over trachea. Litter retracted. Esophagus exposed and isolated about 5 centimeters below level of thyroid cartilage. Left vagus dissected from wall and drawn aside. Defect  $4 \times 2\frac{1}{2}$  centimeters made in anterior wall long axis in that of esophagus. Mucus sponged away. Bleeding vessels not ligated. Fascia lata slightly larger than defect sutured in place. A few reinforcing sutures. Layer suture of wound.

**Postoperative course.** Fluid diet for first week. Animal considerably emaciated at end of that time. Improved promptly with soft diet. Chloroformed March 17, sixteen days after operation.

**Postmortem examination.** Enteresophageal connective tissue extensively adherent at site of opera-

tion. In this situation esophageal wall felt infiltrated. No evidence of stenosis with esophagus *in situ*. After removal of specimen and marked distention with fluid slight stenosis noted at level of transplant.

Inspection of interior, many silk sutures hanging free. After their removal a central irregular elevation of tissue noted at site of transplant. Surrounding it a narrow smoothly covered hollow. Beyond that the mucous membrane thrown up in definite ridges toward the defect, merging gradually into the normal esophageal lining in the opposite direction. The whole patch of abnormal tissue measured  $3 \times 1\frac{1}{2}$  centimeters.

**Microscopic examination.** Surgical Pathology, No. 3884. The transplanted fascia is broken up into bundles undergoing hyaline degeneration. On both sides of the defect these fuse with the mucosa and muscularis, the physical union evidently being very close. There are many blood vessels (filled with red cells) in the fascia layer about the middle, fewer toward the periphery of the defect. The free surface of the fascia is covered by a thick layer of organizing granulation tissue. Over this the epithelium overgrowth is complete. The layer composed of granulation tissue plus epithelium is raised in villus-like folds, the free ends of which appear very fragile (absent in several places in the stained specimens). The deep surface of the transplant is covered by a thick layer of young connective tissue.

**EXPERIMENT DOG 150.** Male, fair size. Operation, February 23, 1916. Esophagus exposed as in previous experiment at a somewhat higher level. Left thyroid lobe retracted, inferior thyroid vessels ligated. Left vagus and carotid vessels isolated and drawn aside. Section of lateral wall of esophagus  $2\frac{1}{2} \times 3\frac{1}{2}$  centimeters removed. Replaced by fascia lata. Several reinforcing sutures. Wound closed in layers.

**Postoperative course.** Fluids for one week, soft diet thereafter. Emaciation considerable at the outset, never disappeared. Animal in very good condition, however, chloroformed March 17, twenty-three days after operation.

**Postmortem examination.** Slight puckering and stenosis of esophagus at site of transplantation. Surrounding connective tissue adherent. Esophageal wall felt firmer here than elsewhere. Stenosis evidently very slight, as tested by water distention.

Inspection of interior. Silk sutures hanging loose were removed. Irregular ridge  $2\frac{1}{2}$  centimeters long, narrow for the most part, at site of defect. It is elevated into small knobs here and there. Mucous membrane appears to stop at the bottom of the ridge; the covering of the latter being a smooth translucent thin layer of tissue of distinctly different appearance from normal mucous membrane.

**Microscopic examination.** Surgical Pathology, No. 3883. The defect is partly drawn together at the free surface, where it is covered over by a complete layer of epithelium thrown into low ridges.



The defect is drawn together to a lesser degree in the depths where it is filled by a thick layer of connective tissue barely recognizable as fascia undergoing hyaline degeneration and fibrous tissue replacement. Muscle bundles from the esophageal wall are numerous and neatly arranged to the margin of the defect. Nerves are irregularly and gradually thin out toward its middle. Tissues of muscle and connective tissue. There are many large blood vessels throughout the tissue filling the defect but no granulation tissue is to be seen.

**EXPERIMENT DOG 143** Male good size. Operation February 6, 1916. Exposure of the left of esophagus isolated from trachea and left vagus. Section of the lateral wall 3 centimeters removed. Replaced by fascia in the usual manner. No reinforcing sutures. Layer sutured wound.

**Postoperative course** Fluids for one week soft diet thereafter. Emaciation extreme at outset but entirely disappeared. General condition excellent however. Chloroform March 1 on month after operation.

**Pathologic findings** This dissection at the operation which is other one indistinguishable. No significant changes in esophagus. When removed and submitted to maximal fluid distention slight stenosis is visible. Vessel from the interior of an almost imperceptibly slightly elevated cicatrix 2 centimeters long and 1 millimeter to 1 centimeter wide covered by smooth shining tissue continuous with esophageal mucous membrane.

**Microscopic** Surgical Pathology. No 388. Complete epithelial overgrowth. The defect is filled by thick mass of connective tissue in which a fascial structure is not discernible. Muscle bundles extend into and fuse with this layer thinning out as the center of the defect is approached. The tissues of the defect pass over by insensible gradations into those of the esophageal wall. Only the mucous glands in the latter suggesting the line of demarcation.

#### 4. TRANSPLANTATION OF FASCIA INTO GASTRIC DEFECTS

Attention has been called to the attempts by various experimenters to support suture lines of the stomach by transplanting strips of fascia over them. The experiments have not demonstrated clearly that this procedure offers definite assurance of additional reinforcement. Attempts to replace all the layers of the stomach have failed invariably even when the defects were very small.

These attempts were repeated by me with the described modification in technique in a number of experiments because there appeared to be some possible clinical applica-

tions in gastric surgery if the experiments proved successful. Failure followed in every instance. Perforation through the necrotic transplant always occurred no matter what technique was employed. Apparently the transplanted fascia was attacked by the gastric juice and its disintegration promptly followed. This view was supported by the fact that the perforation was almost invariably a smaller or larger one near the center of the transplant and not a separation of the suture lines. Indeed intact suture lines between stomach and transplant with relatively intact fascia adjacent to them were encountered in several of the experiments. The details of all the experiments are unnecessary. The following will serve as examples.

**EXPERIMENT DOG 136** Operation December 4, 1913. Defects 3 centimeters near pylorus. Sheet of fascia from the abdominal wall slightly larger implanted into it. Death within twenty-four hours from perforative peritonitis. Transplant almost completely gone. Only a thin fringe found attached at the suture line.

**EXPERIMENT DOG 73** Operation November 1, 1913. Defect 4.3 centimeters on anterior surface of stomach. Excess mucosa removed. Fascia transplant slightly larger. Several reinforcing sutures. Death two days after operation. Small perforation through center of transplant generalized peritonitis. Omentum adherent to fascia around the perforation. Viscerated from within smooth firm union of gastric wall and transplant. Mucosa congested near the suture line.

Finding these efforts to replace gastric defects by fascia quite futile it appeared of interest in relation to experiences in the human being to inquire if gastro enterostomy would in any way influence the result. The most generally practiced operation for perforated gastric ulcer is suture of the ulcer and gastro enterostomy. Exclusion of the pylorus is added by some surgeons. On the other hand some observers believe that gastro enterostomy is not essential or even desirable in the treatment of perforated gastric ulcer especially because it has been demonstrated that gastro enterostomy does not deflect the gastric contents from the site of a sutured ulcer near the pylorus. Turning to the experiments I performed they consisted in the addition of gastro enterostomy



Fig. 29 A (at left) Small perforation through center of fascia transplant in defect of stomach indicated by probe B Large perforation in transplant into gastric defect firm union between remnant of fascia and adjoining wall of stomach (The cross hatching is due to gauze against which the specimen was pressed)

with and without pyloric exclusion to the fascia replacement of defects near the pylorus. They demonstrate clearly that gastroenterostomy does play an important role has a profound influence upon the result for the fascia transplant healed in place invariably when gastroenterostomy was added. Exclusion of the pylorus was manifestly not a factor for the results were entirely satisfactory without any attempt at its practice. The contrast between the previous group of experiments in which failure followed every effort at fascia replacement of gastric defects and this group in which fascia replacement was always successful when gastroenterostomy was added is very impressive.

Two illustrative experiments follow one with and one without pyloric exclusion. A remarkable feature of the first was the formation of true bone in the tissues at the site of the defect. This is merely mentioned here for the question of bone formation was considered in detail in the section devoted to fascia transplantation into bladder defects. The conditions were analogous except that in the bladder experiments the necessary calcium salts were of course much more readily accessible.

EXPERIMENT DOG 207 Large male Operation April 3, 1916 Incision in right hypochondrium. With its center about 6 centimeters from the pylorus an oval defect 4 x 2 3/4 centimeters was made. Defect replaced by a slightly larger sheet of fascia usual technique six reinforcing sutures. No loop gastroenterostomy.



Fig. 30 Pathology No. 4007 Eight weeks after fascia transplant into defect of stomach. Photograph from periphery of filled defect. A Well developed mucosa resting directly on bone plaque B C artefact

Postoperative course Fluids for one week soft diet for two weeks ordinary food thereafter. Animal always in splendid condition. Chloroformed June first eight weeks after operation.

Postmortem examination Gastroenteric stomach and pylorus open. Omentum adherent at site of transplant so that the external surface could not be seen. No sign of weakness upon extreme fluid distention of the clamped off stomach. Viewed from within the field of operation was a somewhat depressed area about 2 x 3 centimeters smoothly covered over by gastric mucous membrane.

Microscopic examination Surgical Pathology No. 4007 Intimate fusion between the tissues occupying the defect and the adjoining gastric wall. No evidence of the transplanted fascia as such. It is replaced by a closely woven mass of connective tissue. Embedded near its free surface is a macroscopic plaque of bone with many small marrow spaces numerous osteoblasts occasional osteoclasts and a fairly well developed limiting periosteum like sheath. The deposit of bone is sharply limited to the site of the defect. The free surface of the latter is completely covered by the overgrown gastric mucosa. This is seen in varying stages of development from the mature layer at the periphery of the defect to the low irregularly laid down villi toward the center.



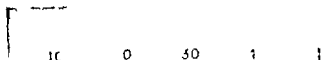


Fig. 34. Pathology No. 2683. Cross section of small intestine through transplant one month after operation. Arrow points to the tissue occupying the defect. The dotted lines indicating the abrupt termination of the intestinal wall at the defect.

tion. Its deep surface is covered by a layer of connective tissue to which omentum is adherent. Its free surface is covered by a layer of organizing granulation tissue over which the gastric mucous membrane has in part grown in an atypical fashion.

# 5. FASCIA TRANSPLANTATIONS INTO DEFECTS OF THE SMALL AND LARGE INTESTINE

Reinforcement of suture lines in the intestinal wall has been attempted both clinically and experimentally with varying results that have already been mentioned. No effort has been made to replace actual defects in either the large or small intestine. For the reasons that have been advanced in the first part of this paper it was of interest to determine if such procedures could be successfully carried out. The following results were obtained. Transplants into defects in the upper part of the small intestine generally failed. Small transplants in the lower part of the small intestine were often successful but the replacement of larger defects not infrequently failed. On the contrary, fascia implantation into these larger defects in the large intestine succeeded in two out of three experiments. In short, there have been failures after transplants into defects of small and large intestine of about the same size as those that have been successfully bridged. These results indicate that though occasionally successful fascia transplantations into in-



Fig. 35. Pathology No. 2683. One month after fascia transplant into defect of small intestine. A Organizing granulation. B Margin of wall of intestine indicated on one side by silk suture. C D Remnants of degenerating fascia. I Artificial defect.

testinal defects is not a very reliable procedure. The results are not comparable with those obtained in the esophageal and vesical defects or in the tracheal defects to be described. Yet the possible practical application must be considered in some of the difficult problems that are encountered in urgent abdominal surgery.

The technique employed was the same as in the other groups of experiments, implantation into and not over the defects. Microscopic



Fig. 36. Pathology No. 2683. One month after fascia transplant into defect of small intestine. Showing epithelium growing over granulation tissue and transition from intestinal wall to tissues of defect.



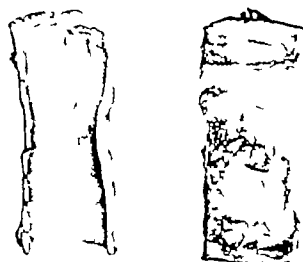


Fig. 30 Pathology No. 3840 External and internal views eight weeks after fascia transplant into defect involving two rings Site of defect between the dotted lines Hardened specimen exaggerating distortion

ence of the field defect was that of a somewhat depressed ulcer healed down to a very small area in the center

**Microscopic examination** Surgical Pathology No. 203 The exact margins of the original defect cannot be determined but there does not appear to be any great shrinkage in size Granulation tissue fills the free surface of the defect and extends into a thick closely woven layer of connective tissue (scar tissue) situated opposite the mucularis and serosa Bundles of muscle fibers principally from the inner muscular layer extend across the position of the defect fusing with the scar tissue The surface of the granulation tissue is covered by intestinal epithelium in several layers toward the periphery of the defect in a single layer almost completely over the middle The omental adhesion is represented by a broad layer of fatty tissue rich in thick walled blood vessels

## 6 FASCIA TRANSPLANTATION INTO TRACHEAL DEFECTS

The first experimental work in this field was performed by Hohmeier He found that



Fig. 41 Pathology No. 384 Longitudinal section through trachea at site of transplant I I Cro's section of cartilage ring at both sides of defect B B the layers of fascia lata C F layers of connective tissue from fascia D D layer of epithelium I silk suture



Fig. 4 Pathology No. 384 External and internal views eight weeks after fascia transplant into large tracheal defect involving three rings Site of defect between the dotted lines Hardened specimen exaggerating distortion

fascia could be successfully transplanted over very small tracheal defects (one half to three quarters of a square centimeter) and that flat epithelium grew in part over the granulation tissue occupying the surface of the defect Davis in replacing similarly small (8 x 8 millimeters) defects found that complete epithelial overgrowth (type of cells not mentioned) developed Larger areas (less than 2 x 2 centimeters) were replaced by fascia in a series of experiments reported by Kostenko



Fig. 42 Pathology No. 384 Enlargement at I in Fig. 41 I continuous layer of ciliated epithelium the cells very indistinctly shown B silk suture intimate fusion of degenerating fascia C C C with connective tissue D around cartilage



FIG. 1. A line drawing of a trachea with a large defect. A flap of tissue is shown being rotated to cover the defect. Labels A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z are placed along the trachea and the flap.

and Kulischew here, however, overgrowth of tracheal epithelium was never seen.

The replacement of minute tracheal defects has little practical importance since ordinary surgical methods accomplish this satisfactorily. If the work of Kostenko and Rubaschew is accepted, the replacement of somewhat larger defects by fascia is undesirable because the exposed granulating transplant would be apt to lead to complications. Clinically the cure of large defects of the trachea is as yet an incompletely solved problem. Complicated plastic operations have been devised in the effort to radically close the fistula. Flaps from the sternum or clavicle have been turned upward to supply the necessary rigid layer of tissue in the gap. For tracheal fistula at a high level flaps from the thyroid or cricoid cartilages have been turned downward. The results that have been obtained by various methods will be detailed later; it will suffice to say here that failure have followed all the advocated procedure.

If experimental transplantation of fascia into large tracheal defects proved completely successful despite the difficulties that exist in the care of animals after such operations, it could be said that the application of this procedure to the human being offers the most logical method of treating such large tracheal defects. In the experiments to be described it was found that very large tracheal defects

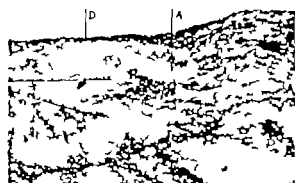


FIG. 2. A line drawing of a trachea with a large defect. A flap of tissue is shown being rotated to cover the defect. Labels A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z are placed along the trachea and the flap.

could be replaced satisfactorily by transplanting fascia into the defect. Very little stenosis followed. The cultured tracheal epithelium grew completely over the transplant soon after operation. Both anatomically and functionally the results were well nigh ideal. In my first experiment the transplant was sutured over the relatively small defect after the method advocated by Hohmeier and others, and leakage and pretracheal suppuration followed. In all succeeding experiments larger defects were invariably successfully replaced without any technical difficulty or postoperative complications by fascia implantation into and not over them.

Experiment Dec. 65. Female m.d. size 10. Operation December 14, 91. Litter 1. Flattened. Vertical incision over trachea middle portion. Trachea exposed at the ring below. Carefully plugging the muscles. Anterior aspect isolated. Short distance. Quadrilateral incision removed from front of tracheal tube. Ring removed. Fascia slightly larger sutured in place. The usual technique except that the tracheal suture took larger bites than usual in the tracheal wall. The stitches were somewhat loose together and every third stitch was tied. Sutured the tracheal musculature as usual. Cottle bottle dressing. No bandage.

Postoperative course. Uneventful. No abdominal emphysema. Primary union. A small chloroform pleurisy 9 p.m. eight weeks after operation.

Result. Slight stenosis of trachea at operation. Small area of overlying muscle firmly adherent. The inner surface of the original defect is covered by a smooth surface layer of tissue continuous with the line of denudation.



Fig. 45. Pathology No. 3048. Two weeks after fascia transplant into a pericardial defect. A. Folded end of degenerating transplant firmly united to cut margin of pericardium. B. B. C. Silk suture at site of junction. D. Smooth layer of tissue on free surface of transplant.

with the normal tracheal lining. The lines of silk sutures are seen shimmering through. By measurement between them very slight if any shrinkage can be determined. After specimen was hardened in formalin vertical section showed shining cut surface of fascia covered on both sides by layers of tissue.

*Microscopic examination.* Surgical Pathology No. 3840. Characteristic structure of transplant remains but there are evidences of hyaline degeneration throughout. Physical union between transplant and the pericartilaginous connective tissue is very intimate. The free surface of the transplant is completely covered by ciliated tracheal epithelium continuous with that beyond the site of the defect. A ridge in the epithelial layer represents the place at which overgrowth begins. The deep surface of the transplant is covered by a layer of thickly woven connective tissue. The cartilage rings at both sides of the defect are capped by masses of faintly staining irregularly arranged cartilage cells indicating budding or proliferation of the cartilage. These caps fuse with the ends of the transplanted fascia.

EXPERIMENT DOG 66. Medium sized male. Operation December 15, 1915. Intratracheal an-

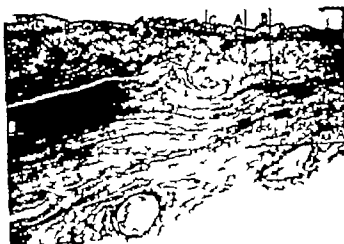


Fig. 47. Pathology No. 3306. Five months after fascia transplant into defect of diaphragm showing the fusion between the altered transplant (A) and diaphragmatic muscularity (B). In this section the continuous layer of pleura (C) is well seen.

esthesia. With same procedure as in previous experiment quadrilateral defect made in trachea included three rings in length and in diameter practically the entire anterior aspect of the organ. Defect measured  $2\frac{1}{2} \times 2$  centimeters. Fascia lita slightly larger sutured in place as in previous experiment. To hold the transplant tense its margin was stitched to the adjoining surface of the overlying musculature in a few places. Layer suture of the wound.

*Postoperative course.* Uneventful. No subcutaneous emphysema. Animal sacrificed February 8, 1916, eight weeks after operation.

*Postmortem examination.* Slight stenosis of the trachea. No adhesions of overlying musculature. Silk sutures visible on external surface. By measurement between them slight shrinkage noted. Appearance of internal surface at site of defect identical with previous experiment—smooth shining layer of tissue continuous with tracheal mucosa.

*Microscopic examination.* Surgical Pathology No. 3841. The findings are practically identical with those in the previous specimen. The ends of the cartilage rings show active proliferation. Fusion between fascia and the tracheal tissues is complete, only the position of the silk sutures marking the

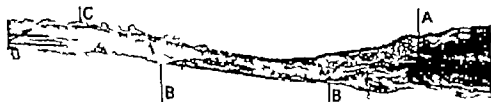
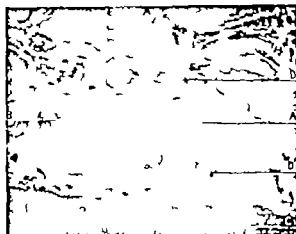


Fig. 46. Pathology No. 3307. Eleven months after fascia transplant into defect of diaphragm. A. Muscle of diaphragm at one margin of defect. B. B. Layer of peritoneum (folded in the section) and C. Layer of pleura spread over the free surface of the transplant.





1. 49 Pathology N 2747 1 month after  
transplantation of the defect of the pleural  
surface. The transplant is completely  
integrated with the surrounding tissue.  
The surface of the transplant is smooth  
and the underlying lung tissue is well  
preserved.

transplantation. The growth of the transplant is  
evident. The chest wall is firm and the  
appearance of the transplant is well preserved.

#### 7. FASCIA TRANSPLANTS INTO PLEURAL DEFECTS

The first and most complete experimental work in this field was done by Kornev. He replicated pleural defects as large as 8 x 6 centimeters and found that with little or no tension practically no changes in the structure of the transplanted fascia were observed even after one year. It is to be noted however that although the true fascial bundles remained unaltered the interfascicular tissues did show distinct changes. This is significant because it suggests ultimate conversion of the transplant into scar tissue. Kornev found a layer of flat mesothelial cells lining the pleural surface of the fascia. Adhesions between lung and transplant occurred very rarely.

The work of other experimenters need only be mentioned. All of Kirschner's experiments were failures, the animals dying of empyema. There were also many infections in Hirano's experiments described in a very incomplete report. Adhesions between lung and pleura were encountered but Hirano believed that these might have been avoided



1. 40 Pathology N 2747 1 month after  
transplantation of the defect of the pleural  
surface. The transplant is completely  
integrated with the surrounding tissue.  
The surface of the transplant is smooth  
and the underlying lung tissue is well  
preserved.

by inducing and maintaining a closed pneumothorax.

Clinically several cases of fascia transplantation into pleural defects have been reported. Iyars is perhaps the most interesting instance. After removal of a tumor of the chest wall extensively involving the pleura a large sheet of fascia was implanted into the defect. Upon examination six months later a recurrence of the neoplasm was found but the chest wall was absolutely firm at the site of the transplant.

All previous experimenters considered it essential to suture the fascia transplant over the defect. The experiments I performed demonstrate that it can be satisfactorily implanted into the defect. In this situation two advantages are seen in the modification of technique. The ends of resected ribs are

not exposed intrapleurally and friction between them and the transplant is eliminated. These advantages were evident to others (Hirano Henschen) but fascial transplantation into pleural defects was not attempted apparently because experimenters believed it would surely fail. Its desirability was especially appreciated by Hirano who suggested that one sheet of fascia be fixed intrapleurally and a second sheet extrapleurally. In my experiments it was found that a single sheet of fascia, sutured into the defect, afforded permanently firm and air tight closure. As will be seen from the following experiment the additional observations at variance with Kornev's findings were. The transplanted fascia loses its characteristic structure relatively soon after operation. Pleural mesothelium grows over the defect not with the normal arrangement of cells but in an atypical form characterized by villus like formations. Very firm adhesions occur between lung and transplant.

**EXPERIMENT DOG 311 Male small size** Operation May 11 1914. Intratracheal anesthesia. Curved incision over lateral aspect of left chest. Flap of skin and subcutaneous tissues turned upward. Three ribs exposed near precordium 5 centimeters of each resected. Underlying pleura removed making a defect  $4\frac{1}{2} \times 3$  centimeters. Sheet of fascia lata slightly larger sutured in place. Very slight tension. No air leakage. Wound closed in layers. Drainage tube placed in pleural cavity through a stab incision near the base of the thorax, stitched to the skin.<sup>1</sup>

**Postoperative course** Uneventful. Drainage tube removed two days after operation. Animal chloroformed October 19 five months after operation. Thoracic wall at site of transplant remained firm and resistant no suggestion of hernia.

**Postmortem examination** Lung firmly adherent to a large part of the area in which fascia had been transplanted. When partly detached it appeared as if pulmonary pleura alone was adherent. A thin layer of smooth shining tissue continuous with the parietal pleura spread over the site of the defect where the lung was not attached. Underneath it there was a firm thin layer of tissue, bright on cross section presumably the transplant.

**Microscopic examination** Surgical Pathology No. 3153. The transplanted fascia has undergone some hyaline degeneration (stains very faintly) and homogeneously in some places contains many blood vessels. It merges by insensible gradations

with the adjoining connective tissue. Silk sutures mark the regions of transition. The free surface of the transplant is covered by a thin layer of connective tissue and this in turn by the pleural mesothelium. This is complete except where the lung is adherent. At several points the new pleural covering is heaped up into large villus masses attached by narrow pedicles. The lung is adherent to the transplant by a layer of dense connective tissue (pulmonary pleura).

## 8 FASCIA TRANSPLANTATION INTO DEFECTS OF THE LUNG

The only studies made in this field were reported by Hirano. He employed fascia to cover wounds and to reinforce sutures of the lung and concluded that bleeding as well as leakage of air from the pulmonary tissues were controlled by the transplant. Upon investigation one finds that Hirano's work is very incomplete (as he himself notes). Four experiments were performed the period of postoperative observation varying from one to twelve days. In the latter instance he found that 'the pulmonary pleura had grown over the transplant. Concerning the technique of operation he advised that the fascia be sutured over the defect, the suture holes in the transplant not overlying those in the lung (to eliminate leakage of air) and that a slight pneumothorax be induced after operation in order to prevent adhesions to the transplanted fascia.

The experiments I performed demonstrate that fascia sutured into a defect of the lung guards amply against air leakage and affords a firm resistant covering for the gap. Owing to the tendency to the development of empyema in dogs the postoperative periods were not sufficiently prolonged to determine the ultimate fate of the fascia. In the limited time of observation however there was no evidence of an extension of the pulmonary pleura over the transplant. In one instance it was interesting to observe how firmly the fascia held in place despite the presence of an infection.

**EXPERIMENT DOG 320 Male medium size** Operation May 15 1914. Intratracheal anesthesia. Incision in the left seventh intercostal space. Flat defect  $1\frac{1}{4} \times 1\frac{1}{4}$  centimeters made on the surface of the lung replaced by same sized sheet of fascia held in place by interrupted sutures. Leakage of air

<sup>1</sup>View of the opened chest cavity. The open end of the pleural cavity was covered with pleural drainage tube. Used for five days.

from one stitch opening. Stream of air either from intratracheal tube discontinued for a few seconds. Lung collapsed. Was permitted to expand slowly. No air leakage followed. Drainage tube through stab wound at base of chest. Thoracic incision closed.

*Postoperative course.* Slight temperature. Drainage tube slipped out of pleural cavity 24 hours after operation. Animal appeared in good condition. Wound firmly healed. Death May 27 two weeks after operation.

*Post mortem examination.* Clear fluid in right pleural cavity, considerable turbid fluid in left cavity. Lungs collapsed, left of rather leathery consistency. Transplant firmly healed in place, could not be dislodged with maximum inflation of lung. Lung and fascia as well covered by a thin fibrous exudate.

*Microscopic examination.* Surgical Pathology No. 3047. The lung contains a fair number of blood vessels near the line of attachment of the transplant. This line is irregular and is made by a thin dense layer of connective tissue containing many cells. The transplanted fascia is still recognizable as such but in many places cannot be distinguished from ordinary connective tissue. It contains many round cells and very few polymorphous leucocytes. Its free surface is covered by a faintly staining layer of tissue containing few cells, a fair proportion of which are leucocytes. The union between fascia and lung appears absolutely complete.

No practical use of fascia as a covering for pulmonary defects has as yet been made. The results achieved in experimental work suggest that it may prove of value in operations for the closure of pulmonary fistulae or for friable raw or bleeding areas of lung encountered at operation. Although not concerned with the question of fascia implantation into lung defects, two suggestions upon the use of fascia in pulmonary surgery made by Henschen on the basis of experimental studies are of interest. One was to induce and maintain shrinkage of a lobe of the lung by ensheathing it with a sheet of fascia. The second was a method of air tight capping of the bronchial stump with fascia.

#### 9. TRANSPLANTATION OF FASCIA INTO PERICARDIAL DEFECTS

The problem of replacement of pericardial defects is encountered in clinical surgery only upon rare occasions. It is then of course essential to restore the continuity of the sac. Suture of the parietal pericardium being impossible or undesirable, plastic procedures

are employed to fill the gap. I believed that fascia transplantation offered a much simpler, more rapid and more efficacious means. This suggestion had already been made by Henschen; he did not, however, attempt to demonstrate its feasibility and it was not taken up by others.

The experiments I performed were not entirely satisfactory, owing to fatal pleural effusions that invariably developed. This well known tendency to the development of pleural complications whenever the thorax of the dog is opened widely evidently had no relation to the operations on the pericardium. Unfortunately, however, it made impossible the determination of the ultimate effects of the transplantation. The immediate results were excellent anatomically and functionally, even when large defects were replaced. Firm union between fascia and parietal pericardium took place despite the little nourishment accessible to the graft and the considerable tension upon it. The inner surface of the transplant became covered by a smooth layer of tissue free from adhesions. The heart action might possibly have been interfered with in one experiment that in which an infection in the pericardium resulted in a thin adhesion of the left auricle. These statements are illustrated in the following experiments.

*Experiment Dog 335.* Small male. Operation May 18, 1914. Intratracheal anesthesia. Pericardium exposed through an incision in the left fifth interspace. Circular section  $4\frac{1}{2} \times 3$  centimeters removed; phrenic nerve avoided. The defect enlarged rapidly by retraction of the pericardium. Owing to this, some difficulty in suture of sheet of fascia lata  $5 \times 3\frac{1}{2}$  centimeters into the gap. Pleura drained by a tube inserted through stab wound near base of chest. Intercoastal and pericostal suture. Incision in soft parts and skin sutured.

*Postoperative course.* Condition good for six days; then became poor. Dog chloroformed May 26, eight days after operation.

*Post mortem examination.* Left lung collapsed, leathery. Considerable purulent fluid in pleura. Fascia firmly fixed in pericardial defect covered by thin fibrous exudate. Pericardial lining smooth. No adhesions to internal surface of transplant which is smooth and bright. Small quantities of clear fluid in pericardial sac.

In most of the experiments reported in this paper, fatal pleural effusions developed, due to anesthesia and the most careful asepsis.

*Microscopic examination* Surgical Pathology No 3048 The fascia has undergone some degeneration but still retains its typical structure. There is round cell infiltration about the sutures that joined fascia to pericardium. A small mass of fibrin seals the chink between transplant and pericardium. The latter contains small areas of blood extravasation near the cut margin. The free surface of the transplant is smooth and is occupied by a thin layer of homogeneous tissue containing few round cells. A similar layer of tissue is spread over the opposite surface of the fascia.

**EXPERIMENT DOG 355** Large female. Operation, June 22 1914. Incision in left fourth inter space. Pericardial defect 3 x 3 centimeters replaced by a slightly larger sheet of fascia. Suture of incision in thorax and drainage as in previous experiment.

*Postmortem examination* Death ensued eight days after operation. Empyema. Lung collapsed, leathery. External surface of fascia transplant smooth firm union between it and pericardium. Dry fibrous exudate in pericardial sac. Thin soft adhesion between the tip of the left auricle and the middle of the transplant.

#### 10 FASCIA TRANSPLANTATION INTO DEFECTS OF THE DIAPHRAGM

The first experimental efforts made by Kirschner were unsuccessful. In several experiments carried out by Ilonnikoff and Smirnofi diaphragmatic defects as large as 3 x 6 centimeters were satisfactorily replaced by fascia. Either omentum or liver was almost always found adherent to the transplant. The outcome of the operation was fatal in a number of instances apparently because the experimenters approached the diaphragm through abdominal incisions and did not employ any method of inflation of the lungs. Henschen also succeeded in replacing large defects of the diaphragm by fascia. He invariably found the adjacent surface of the lung broadly adherent, and therefore considered this necessary for the provisional nourishment of the graft. Henschen and his predecessors believed that it was highly important to fix the fascial transplant over the defect either on the thoracic or the abdominal surface having it sufficiently large to permit generous overlapping at every point. Although histological examinations are not detailed it appears evident that (1) the functional results were excellent with this tech-

nique (2) adhesions interfered with a satisfactory anatomic result.

If fascia transplantation into diaphragmatic defects is to have any possible clinical application it is essential to demonstrate that the tissue in the gap offers a *lasting* barrier to the development of a diaphragmatic hernia or eventration. This had not as yet been done and was the chief purpose of the following experiment. Although somewhat altered histologically after a period of five months the large transplant was found firmly united to the diaphragm and sufficiently resistant to prevent any protrusion of the abdominal or thoracic contents. A unique feature was the complete overgrowth of the pleura on the one and the peritoneum on the other surface of the transplant only a thin adhesion of the edge of the liver interfering with a perfect anatomical result.

**EXPERIMENT DOG 350** Female medium size. Operation June 17 1914. Intratracheal anesthesia. Long incision in ninth intercostal space, left side. Moist packings isolated diaphragm from lung. Defect in diaphragm 5 x 4 centimeters involving tendinous as well as muscular portion. Fascia lata of this size sutured in place. Drainage tube through a stab wound at base of pleural cavity. Pericostal and intercostal sutures. Soft parts and skin sutured in layers.

*Postoperative course* Uneventful. Drainage tube removed in third day. Chloroform administered November 17 five months after operation.

*Postmortem examination* Superior surface of diaphragm exposed by large incision in thorax. Slight adhesion between lung and diaphragm at site of drainage tube incision but no adhesion to diaphragm in region of transplant. The latter was quite indistinguishable except as outlined in part by the curved incision that had been made in the muscular portion. The entire upper surface of the diaphragm is smooth and glistening. Water distention of the abdominal cavity elevated the diaphragm as a whole but did not result in any bulging at the site of the transplant. Except for a thin adhesion of the left border of the liver to the (presumable) situation of the transplant, the abdominal surface of the transplanted area was as smooth and bright as the other. Only when the specimen was removed and held to the light did the position of a number of sutures demonstrate clearly the general outline of the transplant.

*Microscopic examination* Surgical Pathology No 3066 The transplanted fascia shows some degenerative phenomena giving it a hyaline appearance. Its characteristic structure is apparent here and there in the long continuous sheet which

bridges the site of the defect. Many vessels of considerable size (carrying red blood cells) are found in the fascia especially near the margin of the defect. Layers of connective tissue overlie the surfaces of the old red fascia and covering them completely is a layer of pleura on one side and peritoneum on the other. These layers are continuous with the free surfaces of the normal pleura and peritoneum. Silk sutures mark the transition between the transplant and diaphragm; there is no evidence that either the transplant or the defect has contracted. The absolute union between the fascia and the muscle of the diaphragm is remarkably well demonstrated. Regeneration of the muscle across the defect has not taken place.

Despite the striking experimental results it seems probable that a clinical application of the procedure can be considered only in very rare instances. It has been demonstrated in a number of cases that large wounds of the diaphragm can be sutured without any great difficulty (by mobilizing the thoracic attachment of the diaphragm if necessary) and that defects can either be sutured or plugged by neighboring organs: stomach (Albert), liver (Friedrich Anschuetz), spleen (Sprengel), lung (Borchardt). In other instances pedicled flaps from the thoracic or abdominal wall have been turned into the defect. Nevertheless fascia transplantation appears to offer a much simpler solution of the problem and in the future it may be found desirable especially in the surgical treatment of diaphragmatic hernia or eventration.

## 11. FASCIA TRANSPLANTATION INTO DEFECTS OF THE LIVER

Excision of tumors and closure of wounds of the liver have been made possible by improved methods of suturing. It has been found, however, that especially when the tissues are friable the tendency for these sutures to cut through cannot be eliminated. The newer suture methods have been of little aid in the problem of obliterating large flat defects of the liver. In recent years efforts have been made to replace the tamponade treatment of bleeding raw areas of that organ by fixing living tissues in the defect. The object has been threefold: (1) to permit closure of the abdominal wound, (2) to eliminate the danger of secondary hemorrhage after removal of the tampon, (3) to obtain the hæmostatic

action of living tissue. Various tissues have been employed: fat, omentum, muscle, etc.<sup>1</sup>

It has been demonstrated that muscle transplants become necrotic at an early period. Adipose tissue does not offer good support for sutures and is bulky and irregular. Both experimentally and clinically, fascia has been found to answer best the purposes of any transplant in this field chiefly because firm tension can be made upon sutures passed through it and the adjacent surface of the liver and because it covers defects most smoothly.

Various methods of transplanting fascia into wounds of the liver have been described. The adoption of any one of them depends largely on the type of defect encountered. In deliberate excision of portions of the liver as for tumor, some experimenters (Chesson, Kornev, and Schaak) find it most advisable to place the fascia strips upon the upper and lower surfaces of the liver about the area to be excised, using them as supports for the sutures passed through the substance of the organ. Absolute hæmostasis is obtained by tying these sutures. After removal of the desired section of liver tissue the sutures are drawn together and the fascia strips are thereby approximated.

Very few clinical reports of fascia transplants into liver defects have been made. A most interesting case was described by Ritter. The patient sustained a rupture of the liver 6 centimeters long, the tear passing entirely through the anterior border. A strip of fascia 4 x 6 centimeters was placed upon the superior and a similar strip upon the inferior surface of the organ. Sutures were passed through both strips and the intervening liver tissue and were drawn tight without evincing any tendency to cut through. The active bleeding ceased promptly. The patient made a smooth recovery. In Henschen's case a strip from the rectus sheath was satisfactorily employed as a simple covering for an incised wound of the liver.

The determination of the ultimate function of fascia transplants into liver defects is evidently of importance, yet this has not been

Many surgeons have investigated this subject. See, for example, G. J. Johnston, A. H. Koenig, L. L. Loomis, L. W. McArthur, B. S. Soper, S. S. Sucky, T. J. Telford, W. C. Wood.

even approximately estimated. One month has been the longest period of observation after transplantation (Davis). In this instance the small transplant ( $3 \times 0.6$  centimeters) was found viable and adherent in large part to the underlying liver substance. The following experiment is therefore of interest because it demonstrates that, after a period of  $6\frac{1}{4}$  months, the transplant still remains intimately adherent to the original raw area in the liver a very close fusion having occurred. Although largely disintegrated and replaced by cicatricial tissue the purpose of the transplant was completely fulfilled. Well stained liver cells individually and in small clusters were found in the substance of the altered fascia.

**EXPERIMENT DOO 352.** Small male. Operation April 1, 1914. Incision in right hypochondrium. Liver external to the gall bladder packed off. V shaped section removed from the free border measuring about  $3 \times 3 \times 3$  centimeters. Considerable oozing. Defect overrepaired by sheet of fascia  $4 \times 3$  centimeters folded so that it fit both the superior and inferior surfaces of the liver. It was held in place by a number of interrupted silk sutures. Oozing ceased. Layer suture of the abdominal incision.

**Postoperative course.** Uneventful. Animal chloroformed October 19, six and a half months after operation.

**Postmortem examination.** Thin omental adhesion to liver at site of operation and apparently to part of the transplant. Surface of the latter slightly rough but fairly bright and glistening. Absolutely firm attachment of transplant to liver.

**Microscopic examination.** Surgical Pathology No. 3154. Omentum is adherent to one part of the free surface of the liver by a layer of connective tissue. To the remainder of the surface the transplanted fascia is intimately adherent. Here also the attachment is by a layer of dense connective tissue. The free surface of the liver is smooth, its cells being adapted here to the surface of the transplant. Of the latter very little that is recognizable remains. For the most part it is transformed into a layer of loosely woven, faintly staining connective tissue. In some parts replacement by areolar tissue is evident. Scattered through the layer of altered fascia are well stained small islands of liver cells as well as isolated single or paired cells. The free surface of the transplant is in part smooth but has a friable appearance in many places.

## 12 FASCIA TRANSPLANTATION INTO DEFECTS OF THE SPINAL DURA

More than 80 cases of fascia transplantation into defects of the cerebral dura have been

reported, with such uniformly satisfactory results that this application of fascia transplantation can be considered permanently established. Practically all surgeons now employ fascia lata in preference to all the other materials—fat, pericranium, peritoneum, etc.—when the use of tissue transplants is decided upon. The ideal tissue to replace the dura is of course one possessing an identical structure strong and tendonlike consistency and at the same lined with mesothelium. There is however no such tissue that can be transplanted autoplastically in sufficient amounts. Fascia transplanted into dural defects in the human being has been examined after varying periods by von Saar Chari, Denk and others. Adhesions between brain and fascia have been found as well as areas of degeneration in the transplant (Denk's report has already been discussed). Therefore one may conclude that the fascia would be found ultimately converted into scarlike tissue. Functionally however the results in the reported cases were almost invariably good. In some instances (as in von Haberer's case) the transplant remained firmly fixed in place despite most unfavorable circumstances. There are a few cases in which the transplant was with the exception of the skin the only covering for the brain and hernia did not follow. Leakage of cerebrospinal fluid occurred in but two of all the reported cases.

The results of experimental fascia transplantation into defects of the cerebral dura accord with these clinical experiences in a general way except that leakage of cerebrospinal fluid has not been described. It is surprising to find that no experimental efforts have been made to determine the results of transplanting fascia into the spinal dura. If the experiments were satisfactory the clinical applicability of the procedure would be evident. The desirability of always closing the dura in operations on the spinal cord is now generally recognized. Conditions arise in which it is found impossible to suture the dura or in which suture can be accomplished only by compression of the cord. The problem of closing the dura under such circumstances has not been solved. The following experi-

ment indicates that fascia can be transplanted into defects of the spinal dura even more satisfactorily than into defects of the cerebral dura if adhesions to the underlying cord did not develop.

**EXPERIMENT DOG 91.** Male medium size. Operation November 1, 1933. Three spines and laminae removed over lower dorsal region. Dura exposed. Quadrilateral section 3 x 1 3/4 centimeters removed. Operation on the underlying cord of no interest here. Sheet of fascia from over erector spinae sutured into defect with usual technique. Very suture of the spinal.

**Postoperative course.** Uneventful. No leakage of cerebrospinal fluid. Death from distemper December 29, two months after operation.

**Post-mortem exam also.** Evidences of distemper in examination of respiratory tract. Wound firmly healed. Muscle intimately adherent to surface of transplant. Inner surface of transplant smooth and free union between it and adjoining dura evidently complete. Cicatrix in cord the result of the operation on it lay directly underneath the transplanted fascia.

**Microscopic studies.** Surgical Pathology No. 74. The characteristic structure of the transplanted fascia has largely disappeared the tissue in the defect being a loosely woven connective tissue that has undergone hyaline degeneration. In few places flat cells are to be seen. Homogeneous tissue is covering its free surface. A layer of striated muscle is intimately attached to its opposite surface. The fusion between transplant and the surrounding dura tissues is complete. Silk strands being the only discoloration of the line of transit.

#### A CASE OF FASCIA TRANSPLANTATION INTO A CONGENITAL URETHRAL DEFECT

Large fistule of the urethra have been cured by operations consisting in mobilization of the urethra with or without the addition of plastic flaps taken from the corpora cavernosa. However failures have followed such procedures and incomplete successes (strictures of the urethra) have also been reported.

Leakage after suture of the urethra is a complication not infrequently observed and the means taken to prevent it have not proved entirely adequate. The experimental reports of satisfactory reinforcement of suture lines in hollow viscera by fascia grafts and the successful clinical experiences in the bladder (Koenig, Schmid, Korneu) naturally led to attempts to attach fascia strips over suture

lines in the urethra. The results have not been very encouraging. Of four cases described in the literature only one was an unqualified success. This was a male patient reported by Bichrach in whom a urethral fistula persisted after incision of a post-gonorrheal abscess. The margin of the defect was freshened, the mucous membrane sutured and a strip of fascia lata fixed over the suture line. The wound healed by primary union and the patient remained well and free from stricture at the site of operation. In two of the three remaining cases (Klein, Schmidt von Hacker) total failure followed fascia transplantation over urethral suture lines, the fascia becoming necrotic and ultimately expelled and the fistula recurring in both instances. The fourth case (Hohmeier) may be termed an incomplete success. There was no leakage for eight days after an operation consisting in mobilization of a urethral fistula and suture of fascia over the defect. Upon attempted replacement of the permanent catheter that had been used, the tip of the instrument passed through the field of operation. Leakage of urine and discharge of small fragments of necrotic fascia followed. However most of the transplant remained in place and the fistula ultimately closed.

At the outset it was stated that suture or plastic flap methods have cured large urethral fistulae. Considering the discouraging results after transplanting fascia over urethral suture lines, was it justifiable to advocate the replacement of a urethral defect by a fascia transplant. With the experimental experiences as well as the failures after suture and plastic methods in mind, I believed it fair to attempt this in the case to be reported. Very slight leakage occurred soon after operation and persisted for several days, however the transplant remained in place and the patient is entirely well a year and a half after operation. It is realized that a single case is no absolute proof of the value of a method. On the other hand a satisfactory result was obtained despite complications (leakage from one point in the suture line and separation of the skin resulting in partial exposure of the transplant) and despite the

absence of any attempt to deflect the stream of urine from the field of operation by permanent catheter or suprapubic cystostomy. For these reasons it is hoped that the report of the following case will lead others to attempt the method.

Samuel C. 9 years old admitted to the Har Moriah Hospital<sup>1</sup> November 26, 1914 with the history of leakage of urine from the under surface of the penis since birth. At the age of three, an operative attempt at cure of the condition failed (details not obtainable). The symptoms persisted as before. At night there is complete incontinence of urine. The patient has occasional good control during the day, but the mother finds him wet very frequently. When voiding voluntarily usually a large part of the urine (approximately one half) escapes from the floor of the penis, the remainder from the tip. Sometimes most or all of the urine is discharged from the fistula. This happens rarely from the tip of the penis. There is almost always pain on urination.

*General examination.* The child is pale and poorly nourished. There are no other anomalies.

*Local examination.* On the under surface of the penis a short distance behind the glans there is a slightly depressed orifice about two millimeters in diameter surrounded by cicatricial skin. The adjacent subcutaneous tissues are firmly infiltrated. A probe enters into the urethra without difficulty. The normal looking urinary meatus admits a good sized sound that can be passed into the fistula at will but must hug the dorsal surface to pass into the urethra beyond. Upon several occasions I had an opportunity to witness voluntary urination. Usually the fistula leaked urine in rapid drops at the beginning the surrounding skin became greatly distended urine then passed through the fistula in a continuous stream and a little later from the meatus in a small stream.

*Operation,* November 27, 1914. General anesthesia. An elliptical section of the cicatricial skin about 2 x 1½ centimeters was excised with the short fistulous tract. The defect in the floor of the urethra was then found to involve practically all of its ventral aspect, measuring approximately 1½ centimeters in width and 2 centimeters in length. The edges were freshened. A section of fascia lata slightly larger in size and of the corresponding shape was removed from the lower part of the thigh and placed in the defect. Its muscle surface was turned toward the lumen. Ten interrupted sutures of very fine cat gut were passed from the transplant through all the layers of the urethra at the margin of the defect. As a result the fascia was firmly fixed in place its margin slightly overlapping the margin of the urethral defect. The skin was freed and

approximated over the transplant with slight tension. Dry dressing wound in thigh sutured.

*Postoperative course.* The patient voided normally for three days. The dressing was then found to be damp and the wound was inspected. The lowest skin suture had separated and a small area of the transplant was here exposed. Several drops of urine escaped with urination. This persisted for three days. Great care was observed at the necessary changing of dressings.<sup>2</sup> By the time the skin sutures were removed, eight days after operation, the wound was found firmly healed except at the lower angle where a very small patch of fascia was exposed beneath the slightly separated skin. At that time only one or two drops of urine escaped. Two days later there was no escape of urine, although the skin had not healed over. Nor was there leakage at any subsequent period. The wound healed slowly at the lower angle the transplant not being completely covered in until two weeks after operation. The patient was discharged entirely well on December 18, 1914 with complete voluntary control of urination.

At an examination about one month after operation urination was normal the wound was found firmly healed, a slight infiltration being palpable in the depths. This became more pronounced subsequently so that at the end of six months a definite plaque was palpable in the scar. In view of the experimental experiences in fascia transplantation into visceral defects the possibility of bone formation in the transplant was considered. Roentgen ray examination<sup>3</sup> was negative however. The plaque gradually diminished in size and firmness at the present time (June 1916) it is imperceptible.

Endoscopy was impossible in this young patient, so that the question of growth of the urethral mucous membrane over the transplant could not be settled. There was never any evidence of stenosis, as tested by sounds upon a number of occasions. When the meatus was shut off during urination the urethral canal was found normally distended at the site of operation. The urinary stream is normal and is projected normally. There has been no interference with erection as observed by the patient's mother upon several occasions. Nocturnal incontinence ceased promptly after operation and has not returned.

#### A CASE OF FASCIA TRANSPLANTATION INTO A TRACHEAL DEFECT

Reference has already been made to the one instance in the human being of successful fascia transplantation into a hollow visceral defect—Levit's case of fascia transplantation into a defect of the trachea. He was led to employ this procedure by Hohmeier's

<sup>1</sup> Service of Dr. Henry Roth to whom I am indebted for the privilege of operating upon and reporting this case.

<sup>2</sup> I wish to thank the house surgeon, Dr. Hallerman, for the careful attention he gave to this case.

<sup>3</sup> kindly made by Dr. Edgar D. Oppenheimer.



experimental studies and because of the disadvantages of the operations that have been employed for tracheal fistula.

A small tracheal fistula can be closed by cauterization of the orifice a method in vogue for many years. Several procedures have been advocated recently for the cure of larger defects. When the fistula is situated near the cricoid cartilage a favorite operation consists in turning down a flap made of the superficial layers of the thyroid cartilage and the adjacent skin the latter turned inward. The flap is accurately sutured into the defect. Although successful in a number of instances necrosis of the transplanted cartilage recurrence of the fistula and symptoms from protrusion into the trachea have been observed. Furthermore it is a complicated procedure of limited application and can result in necrosis of the thyroid cartilage.

Another procedure consists in the construction of an osteocutaneous flap from the sternum (or clavicle) or a similar periosteocutaneous one. The flap is turned upward and sutured into the defect. The scope of this operation is less limited than the former but it is also less desirable. Recurrence of the fistula and complications in bone healing at the source of the flap have been noted.

To eliminate the disadvantages of flaps a procedure requiring three stages has been employed. A section of rib cartilage is first implanted under the skin near the fistula. After it has healed in place a flap of the transplant with overlying skin is fixed in the defect. At the third sitting the flap is detached and its divided pedicle sutured into the remaining part of the defect. Although satisfactory results have been reported the disadvantages of this procedure are evident.

The drawbacks to these operations having been recognized several surgeons have practiced circular resection of the trachea for the cure of tracheal defects. Some successful cases have been recorded. The operation however is a major procedure (with a possible mortality) depends upon accurate and firm union at every point in the suture line (which may not always obtain in the trachea) and

is applicable chiefly to tracheal defects of large transverse diameter.

In one instance the implantation of a sheet of silver filigree has cured a tracheal fistula. This simple procedure may prove to be a solution of the problem yet the insertion of a foreign body is not comparable with the implantation of living tissue provided the latter serves the desired purpose. The desired purpose was served very simply by Levit for he replaced the defect with a strong and resistant tissue (the object of the complicated plastic operations) which could ultimately be converted into an equally strong and resistant tissue and over which the tracheal epithelium could grow without difficulty (a possibility not invited by the plastic procedures or by silver filigree). Levit's case is as follows:

An anterior median tracheal fistula a short distance from the cricoid cartilage followed attempted suture. Three separate efforts to close the fistula by plastic operations failed. Levit operated under local anesthesia. He removed a section of fascia lata the size of a fifty cent piece (?) (*Silbergold*) and placed it in saline solution. The margin of the tracheal defect was freshened and the fascia placed over it with the superficial surface facing the lumen. The size of the defect is not stated the transplant overlapped by several millimeters. The margin of the fascia was attached to the adjoining trachea by interrupted sutures (catgut?). Some leakage of air and flapping of the transplant were noted and additional catgut sutures were placed controlling both. The skin was undermined and sutured over the fascia.

The wound healed by primary union. Cosmetically and functionally the result was excellent. By laryngoscopic examination the site of operation was represented by a flat white circular scar about 10 to 12 millimeters in diameter the lumen of the trachea was slightly narrowed at this level. The patient was well when seen eight months after operation.

The case I have to report is similar in the findings at operation and in the postoperative course. The technique of operation was somewhat different the fascia being transplanted into and not over the defect. In consideration of possible leakage with the development of subcutaneous emphysema one angle of the wound was drained. The transplanted fascia healed in place without reaction there was no evidence of tracheal stenosis and the patient remained well.

Pauline W. age 20 was admitted to the Har Moriah Hospital August 9 1915 requesting relief chiefly from the cosmetic deformity and difficulty in phonation

Ten years ago a tracheotomy was performed (for laryngeal diphtheria?) The wound never closed An attempt to heal it by cauterization failed The patient coughed almost constantly but did not complain as much of this as of the above mentioned symptoms

The general examination was negative The voice was husky made clearer by placing the finger over the fistula The latter was situated in the midline in the lower part of the neck at the level of the thyroid isthmus The hiatus in the cicatricial skin measured approximately one centimeters There was no evidence of stenosis above the fistula

**Operation** August 17 1915 Local anesthesia The cicatricial tissue and skin about the tracheal opening were excised The defect in the trachea was freshened and then found to be almost circular measuring about  $2 \times 1\frac{3}{4}$  centimeters A sheet of fascia lata slightly larger and of the same shape was removed from the lower thigh and at once transferred into the defect The muscle surface of the transplant faced the lumen of the trachea The fascia was fixed to the tracheal wall by four fine catgut sutures and a continuous suture was made between them (as described in the experimental part of this paper)

There was no leakage or flapping of the transplant with forced breathing A small rubber tissue drain was placed down to the transplant The remainder of the wound was sutured after the skin had been mobilized

**Postoperative course** Uneventful The drain was extruded on the third day and was not reinserted Coughing was subdued but almost constant for the first few days disappeared thereafter and did not return The wound healed by primary union In the first few weeks the field of operation bulged slightly with explosive coughing efforts This ceased subsequently Direct tracheoscopy was not permitted by laryngoscopic examination the site of operation was indistinctly seen as a pale flat, apparently smooth patch

The patient has remained well (February 1916 six months after operation) Phonation is good, she is free from cough and from any symptoms referable to the transplant The field of operation is flat, smooth and firm, no infiltration is to be felt

The fact that the operation of fascia transplantation has been successful in two cases of good sized tracheal fistulae does not of course establish it as the one operation for the condition That it is a much simpler far less dangerous procedure than those previous-

ly employed cannot be questioned In view of the experimental results that are reported elsewhere in this paper and of the clinical results experienced by Levit and by myself I feel no hesitation in urging that fascia transplantation be attempted for tracheal defects before any more complicated operations are essayed With an experience of one case it would be presumptuous to argue for the acceptance of my technique rather than Levit's It may be said that some tracheal stenosis followed Levit's operation, and this was not evident in my case however the defect that was replaced appears to have been larger in his patient It can however be definitely stated that experimentally fascia transplants have successfully replaced large tracheal defects when sutured into them and have failed to cure such defects when sutured over them

### SUMMARY

The free transplantation of fascia into aseptic fields has a wide sphere of usefulness It has proved very satisfactory in the replacement of thoracic defects of aponeurotic defects in operations for various types of hernia and of defects of the cranial dura Fascia transplants have been very successfully used in a variety of ways for the reinforcement or replacement of ligaments tendons and paralyzed muscles They have proved effective as coverings for wounds of solid organs especially the liver Their usefulness has not been clearly demonstrated in other aseptic fields as sheaths for the isolation of nerves as strips for occlusion of the pylorus in fixation or suspension of organs for separation of joint surfaces

There are many advantages of fascia over other tissue transplants (fat, muscle, peritoneum etc.) for the purposes mentioned Fascia (lata) is most readily accessible is obtainable in almost unlimited quantities its removal does no damage Transplanted fascia has a remarkable tendency to heal in place even under most disadvantageous conditions requiring minimal nourishment to obviate necrosis It combines great tensile strength with slight tendency to stretch or to contract It is most readily adaptable to

<sup>1</sup>Service of Dr. A. V. Moschowitz to whom I am indebted for the privilege of operating upon and reporting this case

the shape of any organ and technically can be most easily handled. Finally fascia can be invariably transplanted autoplastically. The other transplantable tissues have some of these characteristics, none of them has all. The ultimate fate of transplanted fascia has not been definitely determined. The experiments I have reported indicate early disintegration in non aseptic fields, degeneration at later periods in aseptic fields. Of practical importance is the fact that the resultant firm connective tissue is as serviceable as the original transplant.

These striking qualities led to attempts to employ fascia transplants in non aseptic fields in the presence of infection or about hollow viscera. A few successes and about an equal number of failures followed. The use of fascia for such purposes was deemed undesirable, the successful results having been considered fortunate accidents.

Experimentally, fascia transplants have been found satisfactory for the reinforcement of suture lines in hollow viscera. They were successfully employed in a few instances to bridge small tracheal fistulae and they occasionally prevented leakage from small esophageal and bladder fistulae. These occasional satisfactory results were found to depend upon healing by contraction of the defect. For this reason failure followed every experimental effort to replace appreciable esophageal and vesical defects.

The technique employed in these experiments on hollow viscera (and on other organs) was the attachment of the transplant over the defect. To offer any chances for uniform success a method was evidently required to prevent the cut margin of the organ from rolling back to give sutures a firmer hold on the organ by passing them through all its layers to more readily supply the graft with provisional nourishment and to invite the overgrowth of the lining mucous membrane of the organ. It is demonstrated in this paper that these requirements were met satisfactorily by suturing fascial sheets into instead of over defects of hollow viscera (and of other organs). With this technique I obtained the following results:

1. Large vesical defects (up to about one

half the bladder wall) were replaced by fascia with uniform success. The functional and anatomic results were excellent. They were attained by the upbuilding of a new bladder wall. Epithelial overgrowth at the site of the defect was complete at an early stage. The newly formed bladder wall was as thick as or thicker than the remainder and equally or more resistant to pressure from within. This was probably due in part to the fact that bone appeared invariably at the site of the defect, definitely limited to that area. The osseous tissues appeared remarkably soon after operation, reaching the height of their development in the second or third month. In conjunction with the bone there was formed typical bone marrow (and cartilage in one experiment) and an ensheathing periosteum like layer of connective tissue. That the transplanted fascia as such was not responsible for the formation of bone was demonstrated by the development of osseous tissue when fat was used to bridge vesical defects. The formation of bone and related tissues was explained by the theory of connective tissue metaplasia, the assumption being that calcium salts derived from the urine were the centers of stimulation.

Another uniform feature was the presence of smooth muscle in the connective tissue occupying the defect. It was continuous with the muscle of the bladder wall. Its presence was accounted for on the basis of smooth muscle regeneration.

2. The immediate anatomic and functional results of replacement of extensive ureteral defects by tubes of fascia were satisfactory. Ultimate results could not be ascertained for reasons that have been stated.

3. Large tracheal defects (involving as much as three cartilage rings and most of the anterior aspect of the organ) were invariably replaced successfully. The anatomic result was ideal, ciliated tracheal epithelium growing completely over the transplant soon after operation. The functional results were satisfactory, the newly formed tracheal wall being rigid and resistant, the narrowing of the tracheal lumen being insignificant.

4. Large esophageal defects were replaced successfully in all experiments. Slight steno-

sis developed soon after transplantation at later stages this was almost imperceptible. Epithelial overgrowth was complete. The functional was as good as the anatomic result.

5 Perforation through the transplant invariably followed its simple implantation into gastric defects. On the other hand smooth healing always occurred even with very large defects when gastro enterostomy with or without pyloric exclusion was added. This striking contrast demonstrates the profound influence of gastro enterostomy upon healing of gastric lesions near the pylorus. *Healing was firm and complete gastric mucous membrane completely overgrowing the site of the defect.* In one instance bone formation in the scar tissue was observed. Its development was explained on a basis similar to that suggested in the group of bladder experiments.

6 Fascia transplantation into small defects in the upper part of the small intestine was occasionally successful. Succeeded more often in the lower part of the small intestine was most successful in the large intestine. In the latter larger defects could often be satisfactorily replaced. Healing took place by the upbuilding of new tissue and partial epithelial overgrowth, as well as by some contraction of the defect.

The following results were obtained in transplanting fascia into defects of organs other than the hollow viscera.

1 The (altered) transplant became firmly and permanently adherent to large defects made in the liver. Previous experiments had only demonstrated good immediate results whereas for stated reasons the determination of the more distant outcome was considered of importance.

2 Large defects of the diaphragm were satisfactorily replaced by fascia. The (altered) transplant healed firmly in place permanently preventing the development of hernia or eventration. Its surfaces were completely overgrown by parietal pleura and peritoneum respectively. Previous experiments had not demonstrated this mesothelial overgrowth. They dealt with immediate results which were good functionally in different anatomically.

3 Large pleural defects were satisfactorily replaced by fascia. The final results were good anatomically and functionally. Overgrowth of pleural mesothelium was complete except where the lung was adherent. Adhesions were not encountered in some previously reported experiments.

4 Good immediate results were obtained in transplanting fascia over large defects of the lung. The firm union prevented leakage of air. The free surface of the transplant was smooth and non-adherent. Final results could not be ascertained owing to the development of pleural effusions.

5 The immediate functional and anatomic results of transplanting fascia into large defects of the pericardium were good. Final results could not be ascertained owing to the development of pleural effusions.

6 Large defects of the spinal dura were satisfactorily replaced by fascia. Adhesions between the incised underlying cord and the (altered) transplant did not develop. Previous experiments and operations dealt with defects of the cranial dura. Adhesions between the transplant and the unoperated brain were encountered.

The clinical aspects are discussed in each of these groups of experiments. In addition, two clinical reports on fascia transplantation into defects of hollow viscera are appended. In one it is demonstrated for the first time that a large urethral defect can be very satisfactorily and very simply replaced by fascia. A similar demonstration is made in a large tracheal defect. This is the second case recorded in which fascia has been transplanted into a tracheal defect.

It is a pleasant duty to close with an expression of my indebtedness to Dr. William C. Clarke, Director of the Laboratory of Surgical Pathology, for many invaluable suggestions and constant co-operation in the progress of this work.

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OPERATIVE IMMOBILIZATION OF THE SPINE<sup>1</sup>

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OPERATIVE immobilization of the spine has as we know been practised at least 20 years. However the first attempts at immobilization were for obvious reasons unsuccessful they were unable to meet the twofold requirements of rapid and permanent support. Chipault and Hadra who proposed and applied wire sutures to the spinous processes or to the vertebral arches certainly achieved rapid but not permanent support as the wire they employed gradually cut through the bone and the latter was exposed to a certain amount of traction. The suggestions of Calot and Vulpinus to employ flaps of periotum obtained from the spinous processes might if successful have achieved permanent but by no means rapid support. The same remark applies to Hibbs and Henle's methods of breaking and forming flaps with the spinous processes. The two above mentioned conditions could only be fulfilled by introducing a strong sufficiently long bone graft. It is by no means essential that the transplanted bone should primarily heal into its surrounding tissues. Its foremost task is rather to provide by means of its inflexibility an immediate and firm support. In the same degree as this support fulfills the function demanded of it will it undergo gradual organization i.e. it will be replaced by new bone which adapts itself both in regard to form and firmness to the demands made on it. The surgeon must by means of an operation pave the way for a more rapid and certain attainment of that which Nature achieves gradually in many cases of Pott's disease and traumatic injuries of the spine.

That was the line of reasoning I followed in December 1911 when in a case of total dislocation between the fifth and sixth cervical

vertebrae I transplanted a spina scapulae into and thus immobilized the lower part of the cervical spine in order to give it nine months after the accident the necessary support. A few weeks later I had for the second time the opportunity of performing the same operation in a similar case. The favorable result obtained in both cases surpassed my expectations and gave me the idea of trying the osseous graft in cases of Pott's disease. Only then I learned that Albee had published analogous attempts a few months before my first operation with the one difference that I employed the spina scapulae and Albee a strip of the tibia. We have since then repeatedly performed the operation in tuberculous cases but being much more skeptic than Albee we have restricted our attempts to twelve cases. We desired first to make sure by means of animal experimentation what carrying power such an implanted bone graft might possess and in what manner its healing in process takes place. With regard to carrying power no results of experiments have hitherto been published and in the works of Henle, Vogel, Clairmont, Erlacher and Vulpinus on back bone osteoplasty there is hardly any mention of the subject. With regard to the healing in process we have among others the standard works on the healing in of bone grafts from the institute of Marchand but Albee's publications prove that as yet there is no unity of opinion on the subject.

Dr. Hoessly was entrusted with the carrying out of our experiments the results of which we here briefly give conjointly.

The nucleus of the osteoplastic operation is contained in the question: How great is the supporting power of a surgically implanted bone graft at the end of the healing in process? The reply this question receives



Fig. 1 Roentgenogram of specimen of a moderately pronounced experimental kyphosis in a dog

must decide whether operative immobilization of the spine be justified or not

We can obtain this reply by means of the two following methods

1 By observing whether in living animals the bone implanted is able to hinder the formation of an experimental kyphosis

2 By applying weight direct to the prepared immobilized vertebral column and thus determining postmortem the supporting power of a bone graft which has been implanted *intra vitam*

To carry out the first mentioned experiment it is necessary to generate a kyphosis. Unfortunately circumstances placed monkeys the only upright animals beyond our reach so that we had to be content with experimenting on dogs. We found<sup>1</sup> that by means of transpontoneally removing vertebral particles it is also possible in the case of these animals to produce a kyphosis which as regards its mechanical origin in no way differs from the spondylitic and traumatic kyphosis of the human subject. We operated on a series of 5 dogs and produced a decided gibbus with an angular bend in the spine of  $10^{\circ}$  to  $30^{\circ}$  (see Fig. 1). We will not here dwell on the manner in which the hump develops, we merely observe that it is not caused by the static weighting of the spine but principally by reflectible muscular traction on the part of the abdominal muscles.

After these necessary preliminaries we proceeded with our real experiments. In five dogs we employed Albee's method remov-



Fig. 2 A (above) Roentgenogram of the spine of a dog two months after osteoplastic operation

B The same spine two and one half weeks after the removal of parts of the spinal bodies situated underneath the graft. No kyphosis formation. A and B have the same direction

ing a slab of bone from the ulna and implanting it on the lumbar spinous processes. About 2 months later on the average after bony union was achieved we again operated on the same dogs and removed ventrally parts of the vertebral bodies from under the bone implant, thus producing a complete gap in the continuity of the vertebral bodies. Whereas as above stated the first series of dogs presented a distinct kyphosis the second series did not show the least deviation from the normal direction of the spine (Compare Figs. 2 a and b). In each case without exception the bone graft prevented the formation of a gibbus.

The next step of interest was to determine the supporting power of the bone graft.

To determine this question those parts of the spine which in accordance with the method above described had been previously immobilized by means of osteoplasty were dissected and a piece of bone was then excised from the ventral side of the corresponding vertebral body. The whole specimen was then changed in the direction of the backbone axis and the weight gradually increased until a slight curving of the inlaid bone and an approachment between the

<sup>1</sup>Detailed records and report of experiments have appeared in Dr. Hoessly paper: D. "Zentralblatt für Chirurgie" 1912, Nr. 10, S. 1012. Die Verhältnisse sind der Spondylitis tuberculosa. Bei Nr. 10, S. 1012.



vertebral bodies was just apparent. The investigation of several specimens proved that a weight of from 30 to 40 kilograms was supported by the immobilized portion of the spine without the least sign of curving. The accompanying sketch illustrates the mode of procedure (Fig. 3).

The experiment will become more clear if the reader takes into consideration the physiology of the spine. The latter serves the human subject in the first place as a body support and the supporting power of the dorsal and lumbar spine depends entirely on the uninterrupted continuity of the vertebrae. Therefore if the vertebral bodies suffer only a slight defect as for instance occurs in the case of traumata or caries the spinal column must break down and cave in to the front or sideways a process that has been fully described by Menard.

The experiments just described prove that the implanted bone graft is capable of preventing a collapse of the vertebral bodies. Thus it fulfills the mechanical demands made on it at least to a degree exceeding our expectations.

The results of this animal experimentation induced us to make similar tests as to the supporting power of spontaneous bony growths between the spinous processes in human specimens of gibbus. Here also it proved that natural dorsal ossification possesses no slight supporting power; it amounted in fact in the specimens at our disposal to as much as 30 kilograms. This spontaneous ossification about the spinous processes of the backbone which had already been commented on by Bricket led Albee to follow Nature's course in undertaking the support bringing operation. However up to the present time we have been unable to form a correct estimate of the supporting power of this dorsal ankylosis. Even Menard with his extensive experience in the treatment of Pott's disease maintains that it provides no support whatever. The reason that this natural dorsal ankylosis cannot prevent the curving in of the backbone is easily explained. Its formation is too slow and too gradual; months and years being required for its completion. Meanwhile the slow ossifica-

tion and gradual immobilization must be accompanied synchronically by at first a gradual later on by a more sharply pronounced curving of the spine. The spontaneous deposits of osseous tissue are, therefore too late to prevent a hump forming. We observed further that a considerably thicker and firmer bone graft may be employed for the operation in the case of the human subject than in the case of dogs and that the firmer graft will also afford greater support. (Graft from tibia Albee, spina scapulae de Ouervain, median border of scapula Ombredanne rib Toblasek).

We shall further remind the reader that Albee has also implanted bone grafts into the spinous processes of dogs. He did not however destroy any of their vertebral bodies so that the conditions for a kyphosis were lacking and the bone inlay was in no way subjected to traction or pressure. The transplantation was therefore carried out on perfectly normal spines. It stands to reason that these animal experiments could not determine the carrying and supporting ability of the bone graft and therefore could not determine its therapeutic value for backbone osteoplasty in cases of static insufficiency. Albee's experiments could indeed serve no other purpose than to determine microscopically the condition of the transplanted bone. The following discussion will show how far our own preparations enabled us to agree with the investigations and conclusions of Albee.

#### MICROSCOPICAL INVESTIGATIONS OF AUTO TRANSPLANTED BONE GRAFTS

Albee says with regard to the fate of transplanted bone grafts. The exact knowledge of the histological role which the bone graft plays is fortunately immaterial to its usefulness whether it serves as an osteoconductive scaffold or as an active osteogenetic force. With this view we agree as long as merely the surgeon's view of the matter is concerned. To him it can be immaterial whether the implanted bone graft undergoes any changes, whether it is only an osteoconductive scaffold or whether it remains an osteogenetic force if only the clinical

usefulness our experiments prove is present. Our experiments have however led us to form other conclusions than Albee as to the fate of the implanted bone.

For the purpose of histological investigation the transplanted bone grafts were hardened in Mueller's formal solution then decalcified and imbedded in celloidin. The sections were tinted with hematoxylin and eosin some of them with Van Gieson. Series of sections from transplants which had remained in the animal two four and six weeks others five to eight months were minutely examined. Thus it was possible to judge the fate of the bone at various periods after transplantation under the most favorable conditions. The only possible way of deciding whether bone fragments live or die is in fact to make a thorough microscopic examination of them and above all of the osseous cells in all their details (Marchand). As all details will be found in the original paper of Dr Hoessly we shall give here only a brief summary of our results.

a. *The investigation of bone sections from fortnight old transplantations presents the following.* Lower magnification reveals nothing special in the bone. The color of the latter is certainly somewhat pale but normal and both the bone cells and tissue in the marrow spaces and canals seem to have undergone no change. It appears in fact as if the transplanted bone would as such continue to live. Higher magnification (homogene immersion) proves, however that such is not the case. We find the bone cells in the median area of the transplant greatly changed. Some of them are shrunken, and in general they are quite pale or show no color whatever. These conditions prevail in all parts of the transplant whereas the bone cells of its bed i.e. of the spinous processes are everywhere well preserved and present normal form and coloring. Only here and there in the border zone of the bone lamellæ just where the latter adjoin the marrow cavities and Haversian tubes are to be seen, in contrast to the light red original bone some new bone lamellæ of a darker reddish blue tinge which present as their most prominent characteristic well formed normal darkly

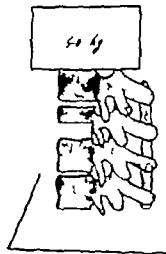


Fig. 3

tinted bone cells reposing in the cellules (Fig. 4). In the marrow cavities and tubes there is now no longer any dead tissue but everywhere numerous young blood vessels young connecting tissue richly supplied with cells and what is more important the marrow cavities are lined with a high layer of cubic osteoblasts (Figs. 4 and 5). The presence of these osteoblasts points to a rich endosteal proliferation. While as before mentioned here and there in the periphery of the bone beams new bone lamellæ originate. They proliferate toward the old bone and are at length separated from the latter by only an extremely fine bluish boundary line (festoon formation of the bone lamellæ Marchand). (See Fig. 5 x). Nowhere in the neighborhood are small celled inflammatory infiltrations or more decided necrotic foci to be found. In different spots we observe that high osteoblasts leave their cell community and wander into the newly formed bone lamellæ where they become characteristic bone cellules. This eradication of the old bone by the new bone lamellæ is apparent in every section and presents only quantitative differences.

These histological discoveries which coincide with those of Radzinsky, A. Barth, Fischeoeder, Valan, Marchand, and Axhausen — some authors we mention as having devoted their attention to the question of bone transplantation — permit of no other conclusion than that bone transplants in the vicinity of the spinous processes which have



Fig. 4. Formation of old transplant on the bed of the transformed bone lamellae on the bed of the bone. The new bone lamellae are already formed in the center of the old transplant. The new bone lamellae are already formed in the center of the old transplant.



Fig. 5. Formation of old transplant on the bed of the transformed bone lamellae on the bed of the bone. The new bone lamellae are already formed in the center of the old transplant. The new bone lamellae are already formed in the center of the old transplant.

autoplastically healed in are ultimately doomed and that in the place of the old bone a new bone is generated by means of lamellar apposition. The originally transplanted bone is therefore from a histological point of view doomed to death and is replaced by a new bone. The new bone generates in the following lines: From out of the bed of the transplant, i.e. from out of the pin u processes new blood vessel proliferate and grow into the tubes of the original bone. Osteoblasts immigrate, multiply and gradually line the original bone cellule and new bone lamellae form. Axhausen's and Selye's investigations prove without a doubt that the covering of perosteum contributes materially to the regeneration of the bone. The chief factors in this bone regeneration are however the bone-forming cells in the bed of the transplant. Even if in the first night old transplant is lifted in traces of bony framework leave it open to doubt as to whether it has or such continued to exist it does not in any way alter the fact that the transplanted bone as a whole dies in the neighborhood of the spanous process and

in the case of transplants in the region of the skull and extremities replaced by new bone. Such part of the bone as survive the grating process and are able to live on are found only in the cases of very young animals and in peripheral zones where the conditions for their nourishment immediately after the transplantation are favorable. The central bony framework however that is to say by far the greater part of the bone dies in the manner above described and new bone-lamellae form in the place of the old bone. The fate of the bone cells has hitherto been a disputed question. Our investigation now permit us to assume that the cells of the original bone are mostly employed in building up the new product.

**3. Bone graft in elgated three weeks after transplantation** present on the whole qualitatively the same features as described under 1. We have only to add that the old bone has undergone further reduction and has been replaced by new bone lamellae. In several places the sections present completely transformed bone lamellae containing even where well preserved bone cells. Further we find in different part of the periphery of the transplant lacunae containing osteoclast

which help to eradicate the old bone by means of erosion. A small number of these osteoclasts are also to be found in the fortnight old transplant.

As regards the union of the bone graft with the spinous processes. It consists in the fortnight old specimen chiefly of fibrous connective tissue and not until the transplant is older do we see here and there bone lamellae growing over from the spinous processes into the bone insert. In some spots they are very numerous and form coral shaped branches. We must however mention that in between the new bone cartilaginous islands are to be found. Their presence proves what is easily to be understood viz that the union between the bone graft and the spinous processes is not yet absolutely firm. In sections of older transplants this cartilage has disappeared.

c. The examination of sections of bone grafts four to eight weeks after transplantation reveals no sign whatever of the original bone. All the bone lamellae have well preserved and good tinged bone cells. The fusion of the graft with the spinous processes is complete and in the bone itself there is nothing to determine the line of union between the former and the latter. We have only to note that the structure of the new bone in the graft is more compact (more sclerotic) than in the original transplant besides which we see at intervals spicuous marrow cavities which have originated in consequence of resorption. On the whole however the new bone formation presents the same dimensions as the original bone and what is most important the presence of rapidly increasing osteoblasts in the periphery of the graft and the constant calcification of fibrous tissue shows that even eight months after transplantation ossification is still going on. With these facts as a basis we assume that the graft increases in size and that more especially when it is called upon to supply support. That is of course the function it is expected to fulfill in all cases of clinical transplantations in the region of the spine. A proof of the correctness of our assumption is shown in the case of R. W. the first operation of this description performed by

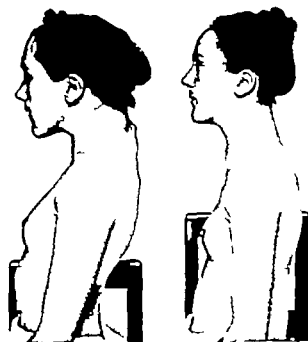


Fig. 6 Spontaneous dislocation of the fifth cervical vertebra toward the front.

Fig. 7 The same case eight weeks after the operation.

de Quervain five years ago. The latest X-ray plate shows a distinct enlargement of the transplanted bone plate.

It goes without saying that we have only employed such transplantation cases for histological investigations as have healed without the least sign of infection by primary union.

We have repeatedly accentuated how important it is in forming an opinion of bone transplantation to carry out the most careful microscopical examinations and to study the condition of the bone cells. All other methods such as the injection of blood vessels and feeding with madder during the process of transplantation do not enable us to form an opinion as to whether the transplant will live or die. Even the plentiful supply of blood vessels in a transplanted bone graft upon which Albee lays so much stress (profuse bleeding when the bone is incised) is not sufficient as young blood vessels can just as well proliferate into a freshly transplanted bone slab as into mortified material (bone boiled or chemically prepared) or even into dead material (sponges). Only the periosteum and bone cell can afford a sure criterion for the histological

condition of a transplanted bone slab in fact for the biological condition of any tissue. As far as we can judge from Albee's publications he prepared and investigated only such sections of bone grafts as had been transplanted at least two months and so he had not the opportunity of observing the important transformatory stages of the first weeks after transplantation. This will account for his assumption that the bone remains as such alive.

The fact that an autotransplanted bone slab for the greater part dies and is replaced by new bone explains how it is that healed antiseptically prepared necrotized even de-vascularized bone can also be successfully employed as a transplant. They can all if the operation be performed under absolutely aseptic conditions heal in by primary union and all undergo transformation in the above described manner. The advantage of employing trephane autoplasmic material is however that the transformation of the original to the new bone is thereby facilitated because the young blood vessel and bone forming cells can proliferate more easily into the old blood vessel tubes and the process of destruction and rebuilding up of bone substance is made easier (Mischak). For this reason I am inclined to believe that Albee's advice with regard to the extent and preparation of the bone graft is of a rather theoretical nature. Whether we chip out the bone graft with a chisel or with a specially constructed trephine whether or not we incise the periosteum of the bone graft in order to facilitate the process of osteoplastic proliferation can certainly be of no importance if only the transplantation be attended by success. Neither is it necessary to keep the bone graft in salt solution or in sterile saline. The paramount condition for a successful union is a strictly aseptic and rapid operation. The chief aim to be borne in mind when immobilizing the backbone by means of osteoplasty is that observed by Albee and de Quervain. Both employ a solid and compact bone slab which from the beginning insures thorough immobilization and

provides the spine with the essential support. All operative efforts hitherto made to promote ossification in the posterior region of the spine—the breaking and slipping over of spinous processes (Hibbs, Henle) employing strips of periosteum (Calot) or of small strips of bone periosteum (Vulpian)—are as we already asserted in our introductory remarks inadequate for a thoroughly firm fixation of the spinal region in question. All these operative methods are at least in the months immediately succeeding the operation simply unable to provide the spine with immobilization so as a matter of course just these months are in such cases lost in the treatment for instance immobilization of the poudyptic area against which the operation was performed.

Albee's opinion that the bone graft possesses antibacterial force is entirely without foundation (the fundamental principles involved in the use of the bone graft in surgery) and I must say that I myself cannot find a reason for this bacteria resisting quality. Neither do I think that Albee's theory will explain why accidentally infected bone inserts should heal in without suppuration and as a fact I have experienced several such cases in the course of my experiments. The graft can heal in in spite of suppuration in the same manner as infected bone fractures can heal.

Although we cannot declare ourselves as agreeing in every respect with Albee's critical views seeing that our investigation have led us to form another opinion of the healing process we do not wish to criticize the principle of osteoplastic immobilization that Albee first and we shortly after and independently employed with success.

Having now by means of Dr. Hoessly's investigations obtained an exact conception of the mechanical abilities of the implant we are able to give the clinical indications for its use more exactly than formerly although many a question will be solved only by means of long continued observation and this is true especially in cases of tuberculosis of the spine.

As a result of our experiments and clinical

observation we are enabled to sum up the indications for osteoplastic immobilization of the spine somewhat as follows

1 *Immobilization in the case of traumatic injuries to the spine* We consider the operation justified in all cases of traumatic lesions in which the spine does not regain its normal supporting power or causes pain when forced to carry weight or finally collapses (the so called Kummell's malady which our experience shows us is much rarer than literary statements would lead us to believe)

Permanent lack of spinal support is met with in cases of non treated luxations combined as not rarely occurs in the region of the cervical spine with an uninjured spinal cord In such cases the patient is with the exception of his luxation well and competent to work As long as a replacement of the dislocated parts is possible we prefer it to immobilization However if the luxation is so old that an attempt at replacement would endanger the spinal cord immobilization is more rational and according to our experience more effective It was on the latter indication that we undertook our first two operations in this direction We made the observation that the motility of the neck was not as might have been expected decreased but on the contrary increased in consequence of the feeling of greater security the patient had in using the neighboring joints

The indication is less reliable when movement is permanently attended by pain or when the spine is called upon for support There are spinal fractures for instance of the articulatory processes of the cervical spine which probably remain painful for a long time in consequence of traumatic arthritis or of nerve contusion and which lessen the competency for work In such case the surgical immobilization of the spine might be taken into consideration We have operated only once for this condition and should like to accentuate that caution is necessary when dealing with neuropathic individual to be sure that the trouble is of mechanical origin The third indication viz the subsequent breakdown of spinal bodies in the case of compression fractures is

probably the rarest of all We have not yet felt ourselves called upon to interfere in such cases especially as experience shows that consolidation of the injured spinal bodies occurs in the course of time spontaneously and in a very high degree Still we should decide to operate if the angle formed by the spine above and below the injured area should become more pronounced some months after the accident or if a gibbus should subsequently form

2 *Osteoplastic immobilization of the spine in Pott's disease* It was for the treatment of Pott's disease that Albee began using his method of immobilizing the spine According to his reports the majority of his operations resulted favorably The cases we have hitherto treated surgically permit us when taking into consideration the relatively short time available for observation to judge the operation favorably yet we believe that the procedure is still in an early and experimental stage In judging the successes hitherto attained we must be the more skeptic as we know that a great number of spondylitic cases heal without a noticeable gibbus occurring Then again we must repeat that the operation does not effect a cure of the spondylitis but simply provides better mechanical conditions for the healing process we replace the orthopedic corset by a more reliable internal splint A proof that the operation provides more favorable mechanical conditions is that in cases of Pott's disease Nature herself endeavors to supply support by promoting a union of the spinous processes Whether or not we eventually influence the healing process and how extensive our influence may be is a question that only years of clinical observation can decide

The effect of the operation may so far be considered favorable as it immobilizes in the highest degree possible the diseased vertebrae and permits the patient to maintain an upright position and to walk about earlier than would otherwise be the case On the other hand we must ask ourselves whether cauterization is not thereby delayed seeing that juxtaposition of the still healthy parts of the diseased vertebral bodies is now

excluded. We dare not forget that the gibbus formation is in itself one stage of the healing process; as after elimination of the diseased particles the healthy parts meet and grow firmly together. The observation of a larger number of cases during several years will also serve to show in what way the process of cicatrization after operative immobilization of the spine takes place and whether the newly provided mechanical conditions may not for purely mechanical reasons tend to delay its progress. We consider at any rate for the present that patients on whom the immobilizing operation has been performed should not be permitted to renounce the horizontal position until they are entirely free from pain. Let us start from the fact that osteoplastic immobilization of a tuberculous spine is not in itself a cure but the best mechanical means of preventing a gibbus and then try to deduce from this fact the indications for an operation.

The operation seems to us superfluous when pain caused by the weight of the body is not the prominent feature and when an inclination to gibbus formation is not present.

It is optional if it offers the advantage of more rapid immobilization of the patient when the inclination to gibbus formation and pain in consequence of bodily weight and

pressure can be removed by an expedient form of recumbency (ventral recumbency).

It is to be desired in such cases as show a continued inclination to gibbus formation in spite of judicious recumbency. Of this Figure 6 is a good illustration. As a result of the destructive tuberculous process a dislocation had occurred between the fifth and sixth cervical vertebrae. It disappeared in consequence of a suitable recumbent position but reappeared when the spine was again called upon to carry the patient's weight. The osteoplastic immobilization of the spine gave the result shown in Figure 7.

3. *Osteoplastic immobilization of the spine in non tuberculous spondylitis.* There are as we know different kinds of deforming processes peculiar to vertebral bodies and vertebral articulations which have perhaps somewhat prematurely and without a sufficiently firm pathological — anatomical basis been compiled into special classes (Bechterew and Pierre Marie) and which present pain on movement as their prominent feature. In these cases surgical osteoplastic immobilization might be given a trial not with the idea of trying to attain a cure but at least to try to remove or at least mitigate the pain. We have not yet been called upon to perform the operation in any such case but should like to propose its being taken into consideration should an opportunity occur.

## THE EFFECT OF REMOVAL OF THE GALL-BLADDER

## AN EXPERIMENTAL STUDY

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IN 1887 Oddi (1) with the object of determining the functional importance of the gall bladder attempted to produce a continuous flow of bile into the intestine by completely removing the gall bladder from dogs. This had previously been done by Zumboff. The animals operated on recovered quickly and the sections made some time later showed the hepatic cystic and common bile ducts dilated to twice or three times their normal caliber. The cystic duct seemed to be transformed into a reservoir for bile and had the appearance of a newly formed gall bladder. To explain these results it must be assumed that some powerful obstacle is opposed to the continuous outpour

of bile and causes the marked dilatation observed in the bile ducts. This led Oddi to the discovery of a special sphincter of plain muscle at the duodenal end of the common duct. He says that this sphincter is entirely independent of the muscular coat of the intestine. The idea that there was a sphincter muscle at the orifice of the common duct has prevailed since the time of Glisson, but Oddi was the first actually to describe this muscle. Oddi's material did not permit him to extend



FIG. 1. Photograph of the under surface of the liver of a normal dog. The gall bladder is fully dilated with bile.



FIG. 2. Photograph of the under surface of the liver of a normal dog, practically the same size and weight as shown in Fig. 1. The gall bladder of this animal had been removed 214 days previously. Biliary tract also dilated with bile. Marked dilatation of common and hepatic duct.





Fig. 3. Dissection of the abdominal cavity of a dog, 1 day after ligation of the common bile duct. The small stone is at the ampulla of Vater.



Fig. 4. Dissection of the abdominal cavity of a goat, 1 day after ligation of the common bile duct. The stone is in the common bile duct.

his studies of the bile ducts in man but Hendrickson (2) in 1898 studied in detail the entire musculature of the extrahepatic biliary system. He found that there are many individual variations in structure but that these deviations do not alter the general anatomical bearing of this region. He concluded that a separate sphincter muscle exists at the duodenal end of the common duct in man as well as in dogs and rabbits.

Archibald (3) deserves great credit for calling attention to the action of this sphincter and the part that it may play in the etiology of pancreatitis. If pancreatitis is caused by the entrance of bile into the pancreas through the pancreatic duct, its presence in these ducts must be caused by obstruction offered by this sphincter at the duodenal orifice. Archibald found that the pressure in the common duct can be very greatly increased by stimulating the sphincter to contract. He suggests as a periton for paralyzing the sphincter as a possible treatment for pancreatitis and has performed this periton successfully in animals.

Our experiments show that the pressure in the common duct is greatly reduced and as a matter of fact may be almost nil sometime after the gall bladder is removed. We believe this is due to the fact that after cholecys-

tectomy the gradual increase in pressure first causes dilatation of the ducts and eventually overcomes the sphincter entirely. The bile then flows almost continuously into the duodenum and is not forced back into the pancreatic ducts. If this is true it will explain what we feel sure is a clinical fact, namely, that cholecystectomy in many instances will cure pancreatitis.

Dogs, cats and goats were used in our investigation. The latter were employed because of the relationship of the pancreatic duct to the common bile duct. The former enters the latter at a rather acute angle quite a distance from the duodenum. In the dog and cat one of the pancreatic ducts opens into the common duct near the ampulla. All operative procedures were undertaken with the animal under anesthesia and the usual surgical technique was employed. At different times after operation except when death resulted from intercurrent disease the animals were killed under anesthesia and the points of interest carefully examined grossly and in many instances microscopically.

After removal of the gall bladder all the extrahepatic ducts dilate. This could be demonstrated in dogs and cats and to a less extent in goats. The dilatation varied from a very slight degree to twice or three times the

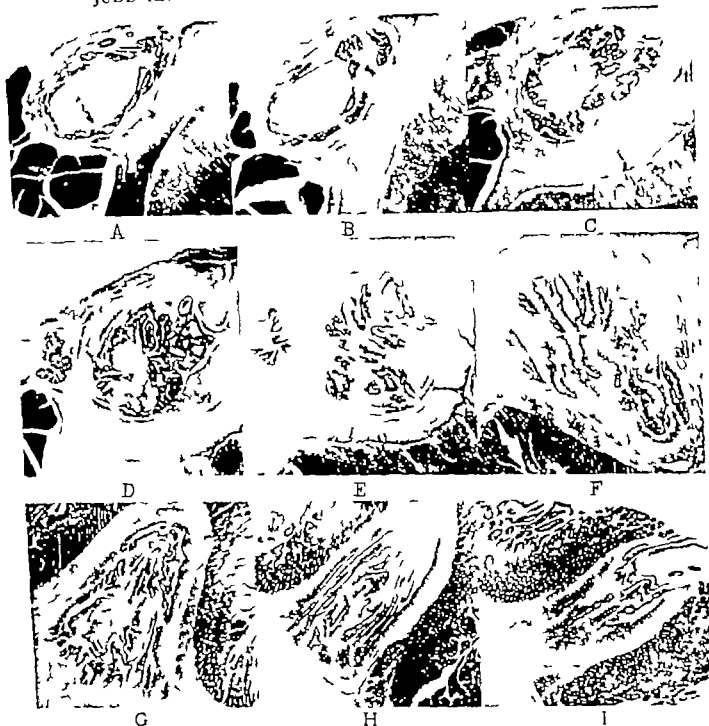


Fig. 5 (cont.) 1b Photomicrographs of cross sections of the different parts of the common bile duct in a cat showing the course of the duct through the duodenal wall. A Duct immediately preceding its entrance into the muscle layer. B Duct as it is beginning to pass through the muscularis. C Duct at one third of the distance through the muscularis. D Pancreatic duct is parallel to common duct.

Fig. 6 1b Photomicrographs showing the same duct as Fig. 5 in its passage through the muscle wall. D Common bile duct and pancreatic duct parallel to each other.

normal diameter of the ducts. However no dilatation was observed in the ducts within the liver substance and the intramural portion of

with the former in the center of the muscularis. I Ducts still parallel the common bile duct almost on the mucosal side of the muscularis. J Duct about to unite passing through the muscularis.

Fig. 7 Photomicrographs showing the same duct as Fig. 5 and 6 on its passage through the mucosa. G Common duct has just passed through the muscularis; the muscularis still is seen. H Duct has apparently entered the mucosa; the muscularis mucosa well defined. I Opening of the duct into the duodenum.

the common bile duct is dilated to a less extent than the rest of the duct. The greatest dilatation of the biliary tract occurs at the



Fig. 1. The common duct just above the junction of the cystic duct.

Fig. 2. The common duct just below the junction of the cystic duct.

junction of the hepatic duct from the upper lobe of the liver. The cystic duct was found to be dilated in a few instances. That this condition was not noted more often we attribute to the fact that usually when a cholecystectomy is done the cystic duct is ligated very close to its junction with the hepatic duct in ligament cuts the true common duct is found below the entrance of the cystic duct. In general dilatation of the biliary tract occurred within 60 days after the removal of the gall bladder in any dog or cat, but the time necessary for this change to be accomplished was variable. No changes were ever observed in the liver or pancreas and even in the pancreatic ducts always appeared normal. The following experiment is typical:

Experiment 1469. Oiler, 9. A male dog, weight 11 lbs. The gall bladder was removed. The pancreatic duct was cut at the time of opera-

tion. 6 millimeters. The animal was killed with the fluorine, 9.6. The operative field was good. The common duct was dilated to a diameter of 1 centimeter after entering the wall of the duodenum. Its diameter was only 6 millimeters. The cystic duct had been completely ligated at the time of operation. All of the branches outside of the liver were dilated. The pancreatic duct seemed to be of normal size. The pancreas and liver were normal grossly and microscopically.

It is desirable to know the exact mechanism by means of which this dilatation is produced. As the increase in the size of the duct took place throughout its entire course it is evident that the cause of the temporary obstruction and resulting dilatation must be located at its distal end. The most probable cause for this obstruction is the sphincter Oddi. The part of the sphincter which is producing dilatation of the biliary tract after cholecystectomy we have investigated by three methods: (1) by comparing the pressure



Fig. 10 Photomicrograph of one of the bile ducts of a dog showing a cross section of an ascaris in the duct  $\times 10$



Fig. 11 Photomicrograph showing the biliary epithelium and the ascaris more in detail  $\times 20$

withstood by the sphincter in normal and control animals (2) by surgically dissecting the duct free from muscle fibers in its passage through the duodenal wall at the time the gall bladder was removed and (3) by sectioning the mucosal opening and a portion of the sphincter through a duodenal incision. The residual pressure of the common duct as measured by a water manometer (which is practically a measure of the pressure which the sphincter Oddi will withstand) is quite variable in normal anesthetized dogs and cats. Deep etherization and long periods of anesthesia together with the exposure and trauma of handling seem to decrease the tone of the sphincter and likewise the residual pressure. However it is safe to say that in the normal animal under light anesthesia of short duration the residual pressure is always greater than 100 millimeters water and usually greater than 150 millimeters. These figures are much smaller than those given by Oddi and by Archibald. After removal of the gall bladder the residual pressure is always very low in some cases it was zero and rarely was it greater than 40 millimeters water. The following experiment is representative.

*Experiment 123* March 6 1916 A black female cat weighing 3 kilograms was etherized and its gall bladder removed. The animal remained in good health after operation. August 2 1916 it was again etherized and the water manometer was connected to the common bile duct. A normal cat of approximately the same size (weight 2.2 kilograms) was also etherized and the common bile duct attached to the same manometer through a two way stopcock. The sphincter of the cat operated on withstood a pressure varying between 30 and 60 millimeters water while that of the control animal withstood a pressure of 160 to 170 millimeters water. The common bile duct of the cat operated on was dilated having a diameter of 3 millimeters. The diameter of the common bile duct of the control cat measured 1.5 millimeters. The liver and pancreas of each animal were normal.

In those animals in which the muscle fibers were dissected free from the intramural portion of the duct at the time the gall bladder was removed dilatation of the duct did not occur except when there was mechanical obstruction due to adhesions. The residual pressure in the unobstructed cases was always very low. The following experiment illustrates this point.

*Experiment 176* March 24 1916 A dog male mixed breed weighing 27.0 kilograms. The gall bladder was removed and the common duct dissected free from muscle fibers in its intramural portion. The operation was accomplished with difficulty—in one place the bile duct was accidentally opened but was immediately closed with one silk suture. The animal was quite sick immediately after operation refused food and lost weight but soon regained normal condition. July 18 1916 it was etherized and the residual pressure estimated. The pressure varied between 20 millimeters and 30 millimeters water. There were many adhesions at the site of operation but the duct was not obstructed. The ligature on the cystic duct had cut through into the lumen and many small pin point concretions were attached to it. There appeared to be a slight dilatation of the duct where the upper hepatic ducts joined. The common duct measured 7 millimeters in diameter and evidently was not dilated. The liver and pancreas were grossly normal.

Section of the mucosal opening and a por-





ectopic pregnancy in this type of case became very much disguised but I began also to wonder why the menstrual period in this patient had been delayed. For future reference I noted that the physical signs of a moderate sized hyaline tumor with an enlarged soft cystic ovary could clinically simulate an ectopic pregnancy. This experience was encountered a number of times since then.

(Case II) Rupture of lutein cysts during examination and simulating accidental rupture of an ectopic site.

On several occasions in patients with similar clinical history and the finding strongly suggestive of an extra uterine pregnancy I was almost terrified at the sudden disappearance under the grasp of my fingers of a cystic tumor in the pelvis giving a sensation that was most unmistakable. In each instance I feared there was a rupture of a gestation site and anxiously awaited the reaction upon the patient noting the pulse and watching the faces for increasing pallor. While in three instances the patients complained of a sudden feeling of peculiar discomfort akin almost to pain the anticipated collapse did not set in and I was relieved to see them rise from the examining table dress and after some hours of observation at the clinic or reception ward of the hospital go home and report on the next visiting day. The physical findings were in each case confirmed by several associates. On several occasions also during the examination by one of them a soft cystic tumor broke. Later examination failed in all but one of these patients to reveal this tumor. In one case after several months there was a return of a cystic mass. In one other patient under observation at the Beth Israel Hospital in whom this occurred the impression of ectopic pregnancy ruptured by vaginal examination was so strong that an exploratory laparotomy was resorted to in the interest of safety. There was a moderate amount of slightly sanguinous fluid in the pelvis and a collapsed cystic ovary was found. The histological examination showed that this cyst was lined by a well marked border of lutein cells.

From a fairly large number of instances of

suspected and positive ectopic pregnancy seen clinically during the past ten years there is no condition that in my opinion so closely simulates ectopic pregnancy as the condition just described.

Group III Enlargement of uterus delayed menstrual bleeding. Adnexal enlargement ectopic pregnancy strongly suspected.

While these observations were being made there came to my notice another group of case with the clinical history of amenorrhea of 6 to 8 weeks duration with the physical finding not unlike that of a very early intra uterine pregnancy complicated however by the additional finding of a mass on either side suggestive of an enlarged or cystic ovary. In view of the physical findings ectopic pregnancy still unruptured is very seriously considered. This occurrence has been noted in several patients who desired children. Sometimes the uterus becomes palpably larger and softer before the bleeding takes place and it even seems as though pregnancy were normally progressing. When bleeding does set in it is apt to be scanty and irregular and one is puzzled as to the actual condition. One is surprised in such instances not to see any specially large fragments or membranes or anything suggestive of foetal structure escape from the vagina. Occasionally as in Case R R a membrane is passed. Examination at such time reveals the uterus reduced in size it is firmer in consistence and at the same time the mass on either side is smaller or has disappeared. The chagrin of the physician who has diagnosed pregnancy and the disappointment of the expectant mother can be readily imagined. The patients then stop bleeding consider the diagnosis mistaken and regard the whole matter as a case of delayed menstruation. This may or may not be repeated at some future time. Not infrequently however this termination occurs in women who are rather anxious lest they continue pregnant. They are naturally less interested in the academic question of clinical interpretation and are relieved to see the delayed menses finally set in. It is not uncommon to meet this clinical syndrome in a woman who confesses to having submitted to an attempt at induction of abortion or to



Fig. 1 Case 3. M. I. age 26 married 2 years one child four and a half years old. Last menses delayed five days then bleeding very slightly dizziness and nervousness. No syncope or pain. Uterus slightly enlarged. To right side is mass about size of lemon follicle retention cyst. Curettage showed gestation glands.



Fig. 2 Case 4. R. R. age 24 married five years one child four years old. Last menses delayed three days then brownish stains for four days. Abdominal cramps especially on right side. Operation for ectopic pregnancy. Findings corpus luteum cyst size of small lemon.

have done something to bring on the delayed menses.

In this group of cases no matter what the patient's attitude toward her gravid condition may be I have been obliged to think of three possible explanations for the clinical picture: (1) Delayed menstruation from some undetermined systemic cause, the mass lateral to the uterus palpated at one or more examinations being a phantom tumor. (2) The mass lateral to the uterus is an ovarian cyst or cystic enlargement of the ovary. The pathological condition may account for the delay in the menstruation and the secondary enlargement of the uterus. The cyst in such cases ruptures spontaneously or through accident or trauma and its contents are absorbed. Bleeding follows upon the removal of this inhibitory factor. (3) Pregnancy is actually present either in the uterus or the tube or both; the embryo undergoes dissolution at a very early stage of its development without giving rise to the classical symptoms of early miscarriage or an early tubal abortion. The cystic condition in the ovary or the corpus luteum is secondary to this change. Further study and comparison with recent reports in the literature on this subject have led me to the conclusion that these explanations satisfy distinct pathological entities. The resulting

symptom complex is almost identical in all of them and the most careful investigation is necessary to separate one from the other. The possibility of a phantom tumor must also be taken into account but only in the sense that some of these retention cysts are encapsulated by a very thin cyst wall which may rupture after the gentlest palpation and hence fail of discovery at a second or third examination.

Recently there came under my observation five cases which may be well included in this group of cases of suspected ectopic pregnancy. The first two of these were not operated upon. In the last three cases I have been able to examine and control the clinical findings by operative and pathological examination. They will therefore be reported in detail.

CASE 1. C. W. First seen by me, July 24, 1915. Age 32, married 2 months. Menses began at 13 years, always regular, 28 day type, 3 days duration, unaccompanied by pain. Last menses July 22, 1915. She had had an attack of peritonitis seven years ago when she was confined to bed for two months. No urinary disturbances. No leucorrhoea. On examination July 24, 1915, she was a well nourished, athletic individual, cervix small, almost infantile, uterus small. There was still a small amount of sanguinous discharge from the cervix. In view of the history of urethritis and lues in the husband, the patient was examined for both these conditions. The husband's Wassermann test having





Both kidneys are palpable the right one being deeper and tender. The abdominal scar shows a hernial protrusion at lower pole.

The cervix is small and hard. External os is patent and transverse bloody discharge is slow. Uterus slightly enlarged and well formed. Sound enters 3½ inches to fundus. Brisk bleeding followed the introduction of sound. Right adnexa are thickened left adnexa are markedly thickened and very tender. It was not clear at the time whether patient had had an early miscarriage whether she may have had an ectopic pregnancy or whether the inflammatory condition of the adnexa was responsible for the symptoms. When next seen on April 8 the bleeding had stopped, the uterus was of almost virginal type the right side was free the left adnexa were tender and enlarged.

Her periods became regular again till August, 1913. When next seen September 25, 1913, she had had amenorrhea of 5½ weeks duration. The uterus was again found enlarged and there was a soft elastic area over its anterior surface. Again there was enlargement of the left adnexa and a cystic mass very suspicious of an ectopic pregnancy. Four days after her visit she began to bleed and bled for 8 days there was severe pain on the left side paroxysmal in character which required opiates. She then began to have dysuria and increased frequency of urination. There was no urethritis. This continued for several months. When seen on February 19, 1914, 10 to 15 days after her last regular period she was in good health. The uterus was anterior of average size and somewhat tender.

I lost trace of her for a year and a half. October 2, 1915, she stated that her periods were again regular occurring every four weeks till August 29. Since then she has been clean. The uterus was found high up increased in size and corresponding to a 6 weeks pregnant uterus. The left adnexa were distinctly palpable there was a sausage shaped mass which was tender to touch. Patient went clean for 7 weeks when she bled in the usual way but without pain.

Her history repeated itself again when on March 25, 1916, she reported an amenorrhea of 6 weeks duration with physical findings as before. Her weight in the course of the four years increased from 106 to 122 pounds.

**Summary.** A young married individual with repeated attacks of amenorrhea of 5 to 10 weeks duration with pain, occasional syncope, uterine enlargement and the presence of a mass lateral to the uterus. The data, in other words, were suggestive of an ectopic pregnancy. During the early postmarital months she was not desirous of being pregnant and sought to interrupt it. Later on she was very anxious to have a family and did not succeed. It is questionable whether she had been gravid at all, the histories of each attack are so much alike that, from my observations of her I could not say with certainty that she was ever

gravid. If she was gravid at any time it must have been either an early terminated tubal or intra-uterine pregnancy associated with perverted ovarian or corpus luteum function. While laparotomy and curettage at one sitting would yield scientific data which in this case was lacking it is not improbable in the light of the cases next to be reported that it belongs to the same group.

**CASE 3.** M. L. age 26 married six years, one child four and half years old. Two miscarriages the first two years ago after delayed menstruation of 8 days spontaneous bleeding the second miscarriage one year ago was induced after an amenorrhea of six weeks. Her periods with the exception of these two irregularities always appeared at twenty eight day interval. So reliant was she upon the regularity of her menstruation that this time when she consulted me with the history which will follow she was very nervous and apprehensive lest she have an extra uterine pregnancy. At the first menstrual delay two years previously her physician had suspected ectopic pregnancy but as her bleeding had stopped after a few days with no other untoward symptoms the diagnosis was considered doubtful.

December 29, 1915, the patient reports that her period was 5 days overdue, instead of bleeding freely she only stained, she had no pains but felt dizzy and nervous. She suspects not only pregnancy but some abnormal element in the pregnancy. On examination the uterus is found to be slightly enlarged and freely movable, there is bloody discharge from the external os. To the right of the uterus is a soft thin walled, cystic mass about the size of a lemon which is very tender and has great mobility as if it were suspended in a fluid medium. Patient placed under observation at a private hospital. Examination on three subsequent occasions confirmed the original findings. On the suspicion of an ectopic pregnancy I operated on her December 31. Preliminary curettage for diagnostic and therapeutic purposes. Only hyperplastic endometrial tissue was removed. There were no large organized particles suggestive of chorionic villi. The curettings were examined histologically. On opening the abdomen a moderate amount of sero sanguinous fluid was found in the pelvis. A retention cyst as seen in Fig. 1 was found on the right side. The tube was long and patent, no abnormalities. The uterus was plump and in good position. The left adnexa were normal. There was no fresh corpus luteum in either ovary. In the one pole of the left ovary was a small grayish cyst about the size of a pea. The appendix was also removed as it showed evidences of chronic disease. It was examined later for the presence of decidual reaction.

**Histological examination.** The curettings in this case showed the characteristic gestation glands of Opitz with decidual reaction in the stroma, which also contained a considerable amount of blood. Chorionic villi or syncytial trophoblast were nowhere to be seen so that the question of an

exceedingly early terminated pregnancy was left in doubt. The picture presented by the curettings could correspond with that as seen in the premenstrual endometrium as well as in very early pregnancy. Instead of the characteristic corpus luteum of pregnancy there was this single retention cyst with erythraemia containing a thin slightly stained fluid. The inner wall was lined by a single layer of poorly preserved cuboidal epithelium with here and there clusters of larger pigmented round cells with central nuclei that resembled luteal or pseudo luteal cells. This cyst could be said with certainty not to have originated from a corpus luteum but belonged rather to the simple variety of follicle retention cysts with pigment cells.

**CASE 4.** R. R. age 24 married 5 years one child 4 years old. No previous miscarriages. Her menses had begun at 4 years of age were always regular and of the 30 day type. Patient was admitted to Beth Israel Hospital February 4, 1916 with the following history. Her menses had been delayed 3 days when she began to stain a brownish fluid which lasted four days. During the next three days on three separate occasions she bled as if her menses had come on. There were abdominal cramps and bearing down sensations in the right lower abdomen. Temperature as elicited in the right and left lower abdominal quadrants. The uterus was enlarged to the size of about a five or six weeks pregnant uterus; on its left side was a very tender mass cystic and elastic to the touch the size of a large plum. February 8, 1916 laparotomy. Uterus is enlarged and plump appearance very suggestive of pregnancy. On the left side is a dark yellowish brown cyst of the ovary occupying the greater part of the ovary and the size of a small lemon (Fig. 5). It is bathed in a tinged fluid which fills the pelvis. In view of the clinical history and the normal appearance of the tube the idea of an ovarian pregnancy was entertained. The right adnexa were normal the ovary containing a small corpus luteum in the regressive stage. It is of interest to note that during the patient's convalescence she voluntarily confessed that she had had sounds introduced in order to induce abortion whereupon the above train of symptoms followed.

**Histological examination.** The ovary is practically entirely converted into a cyst. The ovarian cortex is very thin and in isolated portions shows primordial ova and follicles. The corpus luteum cyst on section (Fig. 3) showed a well defined luteum border. The cells are in an excellent state of preservation. The conversion of the corpus luteum into a cyst must have followed the stage of fluorescence (Blut stadium see below) as evidenced by the well preserved connective tissue inner lining of the cyst. February 3, 1916 10:35 days after laparotomy the patient passed a membrane which showed on microscopic examination masses of decidua very distinctive of pregnancy (Fig. 3). There were however no chorionic villi or isolated syncytiotrophoblast pathognomonic of pregnancy. The decidua

was infiltrated with round cells and there was evidence of much blood extravasation. The glands were characteristic gestation glands as in Case 1.

**Pathological diagnosis.** Corpus luteum cyst associating very early interrupted pregnancy. If pregnancy as such could be excluded with absolute certainty we should have in this case a unique example of persistent corpus luteum function with the formation of true decidua simulating clinically as well as pathologically an early uterine ovum or tubal abortion.

**CASE 5.** F. L. age 36 married 9 years 3 children the youngest 3 years old. Her menses began at 13 was of the 28 day type. Her last regular menses was January 11, 1916 when she bled as usual for 5 days. Four days later she began to bleed again and lost large quantities of blood in free and clotting state. There were no urinary disturbances no nausea or vomiting. She also complained of severe pelvic pain referred chiefly to the right side. There was a cystic mass about the size of a small orange (Fig. 4) very tender and slightly movable distinct from the uterus which was of average size. **Clinical diagnosis.** Retention cyst of the ovary or ectopic pregnancy. On laparotomy a thin walled cyst of the ovary of a size previously estimated by palpation was found on the right side. It is incarcerated deep down in the pelvis from which it was dislocated. A small amount of serous fluid was found in the pelvis. **Histology.** Thin walled cyst tunica albuginea well defined. Immediately underlying this is a loose vascular connective tissue layer with a flattened out layer of luteal cells in the process of regression. The innermost lining consists of flattened cells resembling endothelium.

These conditions resemble each other very closely at times and lead not infrequently to confusion and embarrassment. How shall we interpret them? And how shall they be treated?

**The role of the corpus luteum as an endocrinal gland.** Thanks to recent advances in our knowledge of the cyclical changes in the follicle apparatus of the ovary we are able to interpret in an entirely new light certain of these hitherto obscure gynecological phenomena. The corpus luteum which Born had declared in 1900 to be a gland of internal secretion has become recognized chiefly through the researches of Fraenkel as one of the endocrinal series of ductless glands. Fraenkel's clinical observations and animal experimentations have been amply proved by many other investigators. The histologic researches of Robert Meyer, Robert Schroder, R. Ruge III and John Miller in 1912 and 1913 of the developmental phases of the cor-

pus luteum of menstruation and of pregnancy have completed the evidence essential to establish the fact that the corpus luteum exerts a specific influence over the physiological activity of the uterine mucosa. Furthermore, it is the structure in the ovary that represents the organ of internal secretion. This influence of the corpus luteum is manifest in (1) maintaining placental integrity and foetal nutrition during the early weeks of pregnancy (2) determining the pregravid changes in the uterine mucosa with the resulting formation of deciduous tissue, the soil in which the ovum is to be embedded.

If these changes bear a relationship of cause and effect under normal physiological circumstances we ought to anticipate disturbances of such processes under pathological conditions involving the corpus luteum or the young embryo. Thus the formation of retention cysts especially of the lutein variety ought in some way to affect ovarian and endometrial function. And, conversely early embryonal death should be accompanied or followed by degenerative changes in the corpus luteum. In order that we may appreciate the pathology and the clinical importance of these ovarian retention cysts, I will briefly describe the development and regression of the corpus luteum under physiological conditions as summarized by F. Kermauner.<sup>1</sup>

*The corpus luteum histogenesis and developmental phases.* The rupture of the mature graafian follicle according to most observers takes place about 12 to 14 days after the first day of the last menstruation. Very soon conversion of this follicle into the yellow body begins. First those changes set in which may be included under the stage of hyperaemia and proliferation. The cells of the granulosa multiply to many times the number of original layers and take up fatty substances including lutein which impart to it its yellow appearance. The lutein cells are large and polymorphous contain finely granular protoplasm, pigment granules, fat droplets and a vesiculated, for the most part centrally situated nucleus. These lutein cells take the osmic acid stain and are said to contain colloid substances, a fact which is

assumed to strengthen the hypothesis that they are of epithelial character as against the possible origin from the cells of the theca interna. The process of vascularization completes the stage of proliferation. Blood sprouts shoot up from the theca interna and with them connective tissue strands which together result in the formation of a matrix or framework for the lutein cells, the latter are thus arranged into groups. The cells of the theca interna undergo a certain degree of change and are dislocated in isolated portions into the corpus luteum along with the connective tissue strands. These are known as the theca interna lutein cells in contradistinction to the granulosa lutein cells. However the former are always distinguishable as the peripheral layer of cells.

In the center of the yellow body there is frequently seen at this stage a coagulum referred to as the central blood core. It is practically always seen in conditions other than pregnancy and it is maintained by some authors to be a distinguishing feature of the corpus luteum of menstruation. In the pregnant state, this blood kernel is practically never seen. However this is a matter about which there is difference of opinion and the study of a larger number of specimens will have to be awaited before we come to final conclusions. So far no distinct essential differences have been established between the corpus luteum of menstruation and that of pregnancy.

As the connective tissue penetrates the lutein layer more and more, the cavity is finally filled up and the stage of *florescence* or *bluestadium* is reached. Even the blood kernel may be thoroughly traversed by blood-vessels and become gradually absorbed. The lutein cells become gradually larger and more glistening, they are now seen to be surrounded by connective tissue fibrillae while the theca lutein cells begin to disappear. Then follows the stage of *regression*, the lutein cells appear unevenly stained, and the whole yellow margin becomes speckled, the connective tissue becomes hyaline that of the inner lining of the cavity as well. Occasionally a small cyst is the result. In place of the blood kernel there are now pigment

<sup>1</sup> *Mm. 10* is published in *Leipziger Handbuch der Frauenheilkunde*.

masses the lutein cells themselves undergo necrosis and are gradually absorbed. In the clefts of the hyaline connective tissue there remains for some time shrunken cells with irregular dark nuclei very finely granular rests containing fat are retained. Through further shrinking and absorption the whole structure is converted into a white and cicatricial mass stainable with eosin and resulting in the formation of the *corpus albicans fibrosum* which finally also disappears. If one examines sections of an ovary one will frequently find corpora lutea in various stages of development and regression.

Should pregnancy set in the stage of florescence is delayed to a point beyond the second month when a very gradual regression takes place. At the end of pregnancy the corpus luteum is still about the size of a pea and disappears entirely during the puerperium. Occasionally a corpus albicans of pregnancy may be recognized by its content of lime even after the puerperium.

During pregnancy the theca interna cells hypertrophy very markedly and this activity of the cells only stops postpartum. In hydatid moles this process finds expression in the formation of large polycystic tumors which however are benign in so far as they tend to regress completely. These proliferated theca interna cells represent the so called *interstitial gland* of the lower animals. In the human subject they only appear during pregnancy and are often seen well preserved in the early puerperium.

*Comparison of the cyclical changes in the corpus luteum and in the endometrium.* By comparing the appearance of the corpus luteum and that of the uterine mucosa at certain intervals R. Meyer and Ruge<sup>1</sup> have found that there is a striking coincidence in the several stages of the cyclical changes to be seen in both structures. Thus the hyperæmic or proliferative stage of the yellow body corresponds in point of time with the interval stage of the endometrium; the vascularization stage of the epithelial luteal border coincides with the premenstrual phase, the florescence stage is synchronous with the time just preceding the menses while the

stage of regression takes place during menstruation and thereafter. According to the same authors the stage of proliferation occurs between the eighth and twelfth day following the onset of the menstruation; the stage of vascularization between the fourteenth and sixteenth day. The stage of florescence between the seventeenth and the twenty eighth day while the highest degree of activity of the lutein cells as estimated by the greatest amount of swelling takes place about 3 days before the menstrual period. Active regression then follows till 8 days or so after the beginning of menstruation while complete regression is variable and is sometimes much delayed. These estimates refer to menstruation of the 28 day type.

There seems therefore from this comparison of the cyclical changes in the two structures to be an intimate connection between them. If the corpus luteum can determine the pregravid changes which Fraenkel, Loeb and others have definitely proved then it may be properly assumed that in all probability it is also responsible for the induction of the premenstrual changes. Between the latter and the pregravid changes there is only a quantitative difference. Essentially the glands and the decidua are alike. If the ovum is impregnated the decidua becomes more abundant and more conspicuous. If the ovum is not impregnated menstruation sets in. In this connection it is well to mention that menstruation as such is really not a positive uterine function. Nor does it result directly from the presence of a corpus luteum any more than pregnancy results from the same. Menstruation sets in if the ovum is not impregnated (ovum abortion of Loewenthal). The swollen and hypervascularized mucosa induced through the influence of the corpus luteum is by means of the menstrual flow again restored to its normal state. Possibly with the retrogression of the corpus luteum consequent upon failure of the ovum to be fertilized there is either a disappearance of the substance or substances which inhibit bleeding or a regressive change sets in within the deciduous endometrium that results in the liberation of tryptic substances on the

one hand and in antithrombinogen on the other. The effect on the vessels is increased dilation of the capillaries with rupture and bleeding. These substances are purported to have been isolated by Seitz Winz and others.<sup>1</sup> Whether we can imitate the physiological exchange of these substances in now causing diminished bleeding and again in increased bleeding the future alone may tell. The good results reported from the use of corpus luteum and of apotherapy in general cannot be satisfactorily explained until we have more precise knowledge of ovarian hormones. At present we may grant the existence of these two substances within the corpus luteum exhibiting antagonistic properties. I venture the hypothesis that possibly the two substances are derived from the two varieties of lutein cells normally found in the corpus luteum, i.e. the cells arising from the granulosa epithelium the lutein cells proper and those arising from the theca interna cells, the theca lutein cells. These two varieties of cells may lodge in them antagonistic substances not unlike the cells in the anterior and posterior half of the pituitary gland.

*Retention cysts of the ovary in relation to delayed menstruation enlargement of the uterus etc.* If the corpus luteum establishes those changes in the uterus that under normal conditions are intimately connected with pregnancy and menstruation, it is not illogical to assume that pathological alterations of that gland should be associated with disturbances in both of these functions.

First let us briefly describe the origin and pathology of ovarian retention cysts. We will follow the description of O. Frankl<sup>2</sup> also in reference to certain degenerations of the impregnated ovum, viz. hydatid mole chorion epithelioma, and early dissolution and absorption of the embryo.

*Retention cysts of the ovary.* Under certain conditions as pregnancy inflammation and circulatory disturbances large numbers of follicles undergo degeneration. Under the influence of pregnancy chiefly the larger

maturing follicles are inhibited in their growth and they are said to undergo either obliterative or cystic atresia. The latter process usually affects the larger follicles. The granulosa cells and the theca interna cells may be completely degenerated and disappear or there may arise in the atretic follicles especially under the influence of pregnancy a large number of lutein cells. The retention cysts that result are of two varieties: (1) simple follicle cysts with or without lutein cells, (2) corpus luteum cysts. The cysts may reach the size of a walnut to an orange or in rarer instances to the size of a child's head. The largest cysts are mostly without lining epithelium and the ovarian tissue becomes replaced by the cyst. Under the influence of inflammatory hyperemia the larger maturing follicles may undergo atresia with cyst formation. Through confluence of such retention cyst with a hydro salpinx, a genuine tubo ovarian cyst may result. The retention cyst in such a case may be lined with lutein cells. The theca cells of the atretic follicles form abundant lutein cells also all the granulosa rests tend to produce lutein cells.

The corpus luteum of pregnancy does not tolerate the maturation of any follicle there results therefore cystic atresia of numerous follicles. At the same time through hyperemia an abundant transudation is brought about in the follicles that have become cystic and atretic. There results in this way follicle cysts with very active lutein cell formation the cells originating chiefly from the theca interna. At the same time the corpus luteum can also undergo cystic dilation.

The corpus luteum cysts first described by Rokitsansky are to be distinguished from the follicular lutein cysts. They are dilated cystic corpora lutea and consist of a single chamber lined with a very thin wall and very seldom attain a large size. The cavity is filled with a yellow fluid and lined with a yellow brown internal membrane which may be separated as a capsule. Though infection abscess formation in the cysts may take place rupture and hemorrhage may also take place (Pinkow Roll).

The histological examination of the corpus

<sup>1</sup>See L. Wetz, H. and Eisenhut, L. Ueber die biologische Funktion des Corpus Luteum. <sup>2</sup>See also, *Chromosomen Bestandteile etc.* Menschen, med. Wochenschr. 1911, Vol. 30 and 31.  
<sup>3</sup>Leproux, Hand d. Frauenheilk. 44.

luteum cysts presents various pictures depending on the stage of development of the corpus luteum. Cystic dilation follows transudation into its center and finally according to the size of the cysts and the effect of the pressure of its contents the ovarian stroma may be reduced to the minimum. The diagnosis is not difficult when one still finds well preserved granulosa lutein cells which are arranged in the characteristic fashion as seen in the corpus luteum. In case of the cyst occurring at the time when the corpus luteum is in its stage of florescence there may be found a layer of connective tissue lining the lutein cell border occasionally the latter is represented by a hyaline margin containing pigment masses.

*Cysts in mole and chorio epithelioma.* In about half the cases of chorio epithelioma there are found corpus luteum cysts and genuine lutein cysts. After Seitz and Wallart it may be assumed that the same process takes place in the ovary associating mole or chorio epithelioma only in an excessive degree as it takes place in normal gravidity. Fraenkel claims that instead of the corpus luteum graviditatis in tubal pregnancy there is often a corpus luteum cyst but the causal relationship is not established. It may be secondary to the tubal pregnancy as well as primary due to hyperemia irritation etc.

*The early dissolution or regression of an impregnated ovum in relation to corpus luteum cysts.* Fraenkel has shown that in lower animals spontaneous degeneration of a very young embryo is a frequent occurrence. In the rabbit for example of the twelve pregnant chambers (average number of pregnancies at one time) a few do not reach maturity but on the contrary these retrograde become harder irregularly nodular and smaller and disappear entirely while others develop fully. These affected pregnant locules are situated at various points between the retained pregnancies either to one side or between them.

*Removal of the corpus luteum or castration causes interruption in all the pregnant chambers provided this is done before the second half of pregnancy.* If done later this cannot be accomplished. The time of disappearance of the pregnant ova varies between 3 to 10

days. At first the liquor amnii is absorbed then the degenerated embryo approximates the placenta which meantime likewise becomes smaller pale and dry. The embryo shrinks very rapidly to a white grayish strand like structure that becomes recognizable merely by the spinal column dissolving altogether or becomes confluent with the placenta (membranes are no longer to be recognized at this stage) resulting in a solid grayish hemispherical mass or in a mushroom like structure which becomes smaller from day to day. Finally it consists of a few particles of detritus and disappears altogether. The ovarian chamber is later to be recognized externally by a mildly spindle shaped swelling and by its increased hardness. Internally 2 to 3 smaller mucous membrane folds having a longitudinal mesometrial direction mark the place where formerly the embryo lodged. Occasionally one finds at these points amorphous cheesy material or fluid which does not always make its appearance from the vagina because it is usually blocked by the intervening locules. At the end of pregnancy there is no trace of the degenerated ova particularly if the process began early.

In Fraenkel's experimental production of this regressive process i.e. during the first half of pregnancy no bone formation had yet occurred hence complete resorption took place. This is possible so long as bone has not yet been found. After the eighteenth day of pregnancy in rabbits osteoid tissue is to be found also calcified cartilage tissue.

In another series of experiments one ovarian chamber with its contained fetus was removed for control purposes while at the same time the corpora lutea or the ovaries were also resected. The remaining pregnant locules were then traumatized by squeezing them. In a number of these experiments he succeeded in causing the regression of a number of locules thus treated and at the same time proved the possibility of intra uterine digestion or dissolution of bone. Fraenkel observes that nothing remarkable is thus proved because regression of bone or the dissolution of calcium has been observed under other circumstances.

In the human subject this process does not follow as closely as in animals. Doubtless it is possible for a retained embryo to die, become very soft so that it melts between the fingers and then become disintegrated in even a closed ovular sac. However cases were not described till very recently in which *an entire intra uterine ovum becomes absorbed*. If pregnancy was assumed with the greatest degree of probability and later not found it was natural to assume that a mistake in diagnosis was made. In a case which required bilateral ovariectomy Polano<sup>1</sup> and Fraenkel each observed and demonstrated a pregnancy corresponding by physical signs to the skipped period.

In Polano's case it was a four months in Fraenkel's case a two months pregnancy. The postoperative course was controlled very carefully. *No bleeding or escape of any sort was observed*. At the time of discharge of the patients from the clinic the uteri had returned to their normal size by further observation it even appeared smaller as in castration atrophy. Case 1 of my series would fit in precisely with this peculiar type of embryonic pathology.

Polano found that the ovarian tumors in his case were lutein cystomata and hence assumed particularly on account of the unheard of phenomenon of the regression of so large a normal ovum that he was dealing with a hydatid mole. John Miller reported another case about the same time from Menge's clinic. In his case the corpus luteum gravidarum was converted into a cyst. Pregnancy was established by laparotomy when the cystic tumor was removed. The uterus subsequently under very careful observation diminished in size and returned to normal without any external abortion having taken place. These three independent observations, which can scarcely have been exaggerated clinically have all in common the removal of the corpus luteum cysts in other words the same etiologic cause as has been first demonstrated experimentally in the animals. One, therefore, assumes that the removal of the protective glands of pregnancy leads to the disposition especially

of this peculiar form of ovum degeneration. In animals with multiple foetation this occurrence is frequent. In the human species it is the exception and Fraenkel observes that it is probably brought about only by means of this technique. Fraenkel further adds that the period in which the corpus luteum influences pregnancy in women is apparently very limited and varies in different individuals so that even after bilateral oophorectomy at an early stage of gestation further normal development of the ova has been observed.

#### SUMMARY AND CONCLUSIONS

Menstruation in married women is often delayed for periods varying from a few days to a month. During this period of temporal amenorrhoea, the patients naturally regard themselves pregnant. Not infrequently physical examination in such cases of delayed menstruation will reveal the uterus actually changed in size and consistence thus further justifying the presumptive diagnosis of pregnancy. However in spite of this subjective and objective evidence the diagnosis may be left in complete doubt by the onset of the menstrual flow which *apparently differs in no way from the usual menses* for that particular individual. Occasionally in addition there may have been found on palpation an extra uterine mass more or less tender which excites the suspicion of an ectopic pregnancy. This extra uterine mass may make the impression of an enlarged cystic ovary or be more or less elongated and simulate an enlarged dilated tube. Pain in the lower abdomen and cramps may also be complained of. In other words there may be present the essential points in the history and physical findings of the patient to lead to the diagnosis of an ectopic pregnancy. Occasionally too the cystic mass may be unmistakably ruptured by the examining fingers thus further simulating a ruptured ectopic gestation etc. Yet neither in the subsequent course nor at laparotomy is an ectopic pregnancy proved. Instead a retention cyst of the ovary varying in size from a plum to a small orange is the only abnormal finding. This cyst may be a simple retention cyst histologically with or without lutein cells or it may be a genuine



corpus luteum cyst. These arise either as a result of early death of an intra or an extra uterine embryo the subjective symptoms being wholly due to the gestation itself or arising as a result of trauma or degenerative changes in the ovary the corpus luteum cyst may in late secondary changes within the uterus enlarging it softening it prolonging the decidual (pre menstrual) phase and inhibiting the onset of the menses.

From an analysis of the histologic findings in the cases personally encountered it appears that corpus luteum cysts and retention cysts of the ovary may simulate early terminated

intra or extra uterine pregnancy without either of these conditions actually having been present. On the other hand it is more likely that in the majority of instances these retention cysts result secondarily through early embryonal death whether the impregnated ovum lodged within the uterus or within the tube. The ovum is in these instances disintegrated and absorbed and resorption (involution) takes place without the external or internal hemorrhage which we are accustomed to see in uterine or ectopic abortion. In all probability a great many non tragic ectopic pregnancies terminate in this way.

## OBSERVATION OF A SENIOR SURGEON COMMANDING THE SURGICAL DIVISION OF A BRITISH BASE HOSPITAL IN FRANCE<sup>1</sup>

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FROM France last July I had the pleasure of contributing to the *Journal of the American Medical Association* a letter which considered briefly the excellence of organization of the Royal Army Medical Corps of the British Expeditionary Forces in France and also in a minor way ballistics and war wounds. The present paper is purely surgical and very general in its scope.

### GENERAL REMARKS

The training and health of soldiers who exercise freely marching fifteen miles a day carrying an extra weight of fifty six pounds who live an outdoor life have no alcoholic drinks and who are fed on an abundance of good plain food have considerable bearing on their general ability to resist shock and in fected wounds.

Fighting conditions are very unfavorable. Trench warfare is waged in ditches nine feet deep. The soldiers operate in mud and dirt. There is lack of exercise and frequently bowel stasis. The difficulty of transportation of wounded through communicating trenches the compulsory exposure to the elements while lying out waiting to be picked up and the complications caused by secondary wounds

received while lying in transportation or even in dressing stations from enemy fire are also important factors. We received men who had lain as long as six days in the open with no attention no food nor drink and frequently with large areas of painful sunburn from exposure.

Care and supplies are excellent. Rubber gloves surgical dressings medicines and splints are liberally furnished. Iodine is falling off in use as a part of first aid dressing. Cyanide gauze is being largely substituted for it. Casualty cleaning stations the collecting points of several field ambulances are also being discontinued as the great benefit of immediate transportation to the near base hospitals is appreciated. There is not time for any reference to the distribution of wounded to special hospitals in England after their removal from the base.

Pathological and bacteriological study is encouraged. There is also co operation between base hospital units with discussions of general principles in open meetings and through the medium of surgeon general consultants. There should be granted greater freedom to medical officers to report special series of cases and results of particular treat-

ments Opium especially morphine is used freely for wounded men at the front It is generally given by mouth and doses of one half grain are common after injury or before transportation

#### CASE GROUPS

At base hospitals it seems wise to separate the wounded into different wards according to the types of injury I used a system of distribution which gave a head ward chest ward buttock ward fracture of femur ward, etc and found that it helped both medical officers and nursing sisters and was a great convenience for the officer commanding and especially time saving for consultants

1 *Punctured and lacerated wounds* form the majority of all admissions They exist with or without bone involvement and foreign bodies Routine treatment consists in early excision of ragged edges and removal of the foreign body the wadding if cloth being as important as the metal Gas anaesthesia often suffices The X ray must be used in co operation Experience lends the surgeon an ability to follow fresh wound tracts and keen observation of extra tender spots may betray where foreign bodies lie One must not make the mistake of opening limbs filled with blood unless the infection has become alarming and then preparation for large vessel ligation must be at hand The X ray is of great value in making an early diagnosis of gas infection

Practically all wounds trimmed and searched for foreign bodies demand drainage Large fenestrated or split tubes are the best means of affecting this and are combined with installations of eusol (Dakin's solution) This solution can be injected into the tubes every two hours by the nurse with a small hand syringe or can be used by the drop method from reservoirs If dressings are put on wounds irrigation keeps them constantly moist and mechanically flushes the wound Deep infection disappears and healthy granulations appear more quickly with this solution used in this manner than with any other irrigation I have ever seen used Limbs so treated are slung in splints and kept at rest A saline is not necessary on the skin surface if this solution is made up fresh daily as follows

*Eusol* 0.5 per cent aqueous solution of hypochlorous acid Shake up 12.5 grams of boric acid powder and 12.5 grams chloride of lime (bleaching powder) with 1 litre of water allow to stand a few hours then filter The chloride of lime must be dry The solution will remain efficient about three weeks Stronger solutions do not keep It should be stored in colored bottles and because it is destructive to cloth and corrodes metals all instruments should be washed after contact with it Eupad a powder composed of equal weights of boric acid and dry chloride of lime ground together will keep in stoppered bottles

The use of eusol intravenously in 25 to 50 cubic centimeter doses has been advocated in extensive sepsis Although I have tried this without untoward effect, I doubt its value

Hypertonic salt solution 5 to 10 per cent is also used as a wet dressing or irrigation on suppurating surfaces When the solution is not at hand large wounds may be lightly packed with 10 to 20 salt tablets which dissolve in the serum and form a hypertonic solution on the surface This treatment has a distinct value

2 *Head injuries* The use of the steel helmet is an important factor in lessening the severity of head wounds The important aspects of these wounds may be roughly divided into the fractures infections deeply lying foreign bodies and the sequelae

Colonel Warren in a report made to Sir Alfred Keogh, D.G. in July studied the fate of 1,239 head injuries between 2 and 18 months after infliction of the wound Seven hundred of these patients were observed in France and full clinical histories made Mere scalp wounds were excluded unless they led to death or serious complications All were severe cases The mortality was less than 4 per cent, none dying after three months from the date of wound The majority died of meningitis This was my own observation also as I hope to show in a series of cases to be reported later Ventricular infection is always fatal Colonel Warren found no fatal case in which death occurred in England when the dura mater was not lacerated by wound or by operation

Probably much of the early sensory and motor disturbances are caused by edema and circulatory disturbances in the brain. Recovery without interference is possible even in face of complete hemiplegia and deeply lying foreign bodies. Infection is the condition most to be feared.

1. *Permanent mental disturbances* are very rare. I saw two. This does not include shell shock. Major Mott, Pathologist, London County Council Asylums says: Head injury apart from syphilis, alcohol, and hereditary neuropathic taint was seldom the cause of mental affection.

2. *Epilepsy* is less common than believed. I saw several cases resulting from injury. Colonel Warren found 6 per cent. Every head case should be given bromides early to avoid formation of the epileptic habit.

3. *Other neurological complications* are either objective as paralysis, sensory and visual disturbances, or results of cerebral hernia and septic infection. There are also frequent subjective symptoms—the most common are headaches, fatigue on exertion, throbbing attacks of dizziness, and some changes in temperament—or hysterical manifestations. Many of these are like traumatic neurasthenia, and while they incapacitate from active service, they are recoverable and are independent of fracture and whether the patient has been operated on or not.

4. *Cerebral hernia* is fairly common. It is difficult to treat and gives a mortality of 20 to 40 per cent. Colonel Warren found 24 per cent. mortality in cases evacuated to England with cerebral hernia. Of course many die at base hospitals.

5. *Retained missiles in brain*. Soldiers very frequently recover with much betterment of condition and frequently with no trace of damage. English surgeons as a rule are opposed to head operations.

My experience leads me to conclude that in superficial foreign bodies with open wounds one should do a quick removal as in other parts of the body, but do no damage. Make every effort to avoid hernia cerebri.

Emphasis must be laid on spinal puncture for its therapeutic and diagnostic value.

Late results in head cases are unexpectedly

good. Cerebral abscess, insanity, and epilepsy are rare.

3. *Spine injuries*. The symptoms are more definite and less liable to ameliorate than in head injuries. If the evidence shows severance of the cord or a septic tract to the cord, the dura should not be opened. Foreign body or bone pressure on the cord is amenable to operation. Operative opening of the dura invites infection and the meningitis is more or less atypical in symptoms. At post mortem there is a diffuse plastic suppurative meningitis over a large portion of the cord, death generally occurring when the bulb becomes involved. Cases not operated upon frequently live a long time or even overcome infection so that they can be carried home in spite of paraplegia and other hopeless paralyses.

4. *Neck injuries* are frequent and in spite of anatomical condensation of that part of the body many are unimportant. Serious ones die on the field. At the brises are found aneurisms, both false and arteriovenous. Nerve injuries, thyroid injuries with intra capsular hemorrhages presenting symptoms much resembling hyperthyroidism, are met. I had four cases of injury of the cervical sympathetic and five cases of gunshot of the thyroid. Tracheal injuries heal quickly as a rule. Complete lesions of the brachial plexus are rare and one should be slow in making such a diagnosis on account of recoveries which will follow what is apparently a complete severance.

5. *Chest injuries* are common. All types of chest pathology ensue. Old pleural adhesions which prevent lung collapse when the pleural cavity is opened may be the cause of fatal hemorrhage upon lung perforation. Pneumothorax is frequent. Great displacements of the heart right themselves in a surprisingly short time if relief is given by aspiration or drainage. Empyema follows frequently. It often develops after the third week and becomes urgent. All collections of fluid in the thoracic cavity should not be drained until aspiration with a vacuum apparatus and bacteriologic examination have been made. Fluids sterile a few days after injury will frequently go on to empyema in the

fourth week. Suppurative pericarditis is easily overlooked. Drainage of empyemata once established should be thorough and at the lowest point. It is often done under local anaesthesia. The mortality of chest injuries reaching the base does not exceed 5 to 6 per cent. Convalescence should be in special wards or outdoor hospitals.

6 *Abdominal injuries* are for the most part operated on in field ambulances. Extensive resections of gut are unwise because death follows after a delay from sepsis or the combination with adhesions and obstruction. Some cases reach the base undiagnosed and are clamant indications for immediate operation if only on suspicion. A sharp eye must be kept for *extraperitoneal* injuries. Their manipulation and drainage must be made without endangering the abdominal cavity. I had a series of six interesting gunshots of the psoas muscles without abdominal involvement and was able to drain extra-pentoneally and save three of them although they presented fresh *psoas abscess* a rare condition. Not one of these cases pointed in the femoral region where we expect all old psoas abscesses to show themselves. All had flexed thighs on the affected side extension of which was painful.

Bladder injuries give poor prognosis.

Injuries of the external genitals heal nicely but demand long care and later plastics. Buttock injuries are obviously difficult to care for. I found that support on the Bradford frame with air dressings gave the best results.

7 *Extremities* All types of injuries from simple through and through punctured wounds to massive open fractures are found. They are treated on the general principles of wounds except that through and through punctures from rifle and machine gun bullets are usually left alone and frequently heal with no reaction. One must be on guard against blood vessel injury, gas infections and mere contusion of nerve trunks which cause only temporary paralysis. In gunshots of the leg nail extension is a sure method of obtaining continuous traction.

8 *Nerve injuries* are relatively not common. Paralyzing contusions which at first seem complete severance of main trunks will

often show complete recovery in three to four weeks. One should be slow in making diagnosis and never operate in the presence of infection.

9 *Blood vessel injuries* Are interesting and are often overlooked unless there is immediate alarming hemorrhage or a quickly forming aneurism. Vein injuries lead to great distention of a limb which in a few days simulates either extensive pyogenic or gas infection. If these limbs are operated on early vessels generally have to be tied at a distance both proximally and distally. Thrombosis and emboli occur when the infection is late in manifesting itself with resulting ligation of main trunks or amputations. As a rule they are best treated expectantly. Examples of pure arteriovenous aneurisms especially of the femoral or brachial come into the base hospitals. Arteriovenous aneurism with false sacs adjoining and ordinary false aneurism are also seen. It was my good fortune to deal with many of these. Dr Hugh Cabot with the Harvard Unit told me that he had seen none on his service.

Secondary hemorrhages are numerous. I have complete records of more than thirty cases many of which ended fatally. The cases threatening hemorrhage are best cared for in a separate ward with constant watch and air dressings. The femoral, cranial, axillary and gluteal vessels give the worst prognosis. The types of infections in war wounds lead frequently to vessel softening and thrombosis and ligatures should be applied at considerable distance from the wound.

10 *Tetanus* Occurs in spite of prophylactic injections of antitoxin. I had six such cases all treated by massive and repeated doses of antitoxin, intraspinally, subcutaneously and intravenously. Treatment should be started as soon as first symptoms are noticed. Especially interesting are the cases of *local tetanus*. Of these I saved every case which came into the service by the above mentioned treatment, sometimes added to by injection of 2000 units of antitoxin in the main nerve trunks of the limb.

11 *Gas gangrene* May be divided into

two types—local and general that is (a) involving one muscle or one group of muscles in an extremity or (b) massive and general extending quickly up a whole limb. We found that there were four different groups of organisms to be isolated. Welch's bacillus, bacillus capsulatus, streptococcus and an organism closely related to the colon group. With the local infections the prognosis is good after early operation. The skrogram often shows beginning gas formation about foreign bodies and indicates immediate thorough drainage. Amputation is used for the general extremity gas infections and if the extension has been very rapid even this will not save a general septicæmia and death. In Welch bacillus infections the muscle tissue becomes a pinkish salmon like color with the same colored discharge. Other organisms give a soft degenerated muscle which is like soft clay brownish in color resembling faeces in odor and consistency. At operation all such degenerated tissue should be scooped out by the surgeon—the whole length of a limb opened if necessary to make the removal.

12 *Gas poisoning* is also of two classes. Chlorine is the chief constituent of the drift gas. Asphyxiating and lacrimating shells contain other gases, the lacrimating type causing a profuse outpouring of tears and pupil dilatation so that artillerymen and other gunners lose efficient eyesight. The pathology divides itself into that found in the cases gassed to death from general toxic effects, those which develop lung oedema and bronchopneumonia and a third class which develops secondary septic bronchitis, pleurisy and pneumonia. The gas helmets and use of atropine and oxygen have become routine treatment.

13 *Amputations*. Like any civil surgeon I entered war surgery with the most conservative ideas regarding amputations. I now believe more early amputations should be performed. One must consider all the usual rules of civil practice regarding sites, subsequent joint movements for artificial limbs, etc. while the method of amputation is dictated by the severity of infection expected or already present. Guillotine amputations circular with no flaps give excellent drainage and can often be made to suffice without further limb shortening by use of the stump splints and secondary bone amputation where granulations are clean. Some of the worst cases of gas infection I saw followed amputations with sutured flaps.

Amputation with spinal anesthesia is very satisfactory and often possible when a general anesthetic dare not be given.

The military surgeon constantly meets his old civil friends even in the rush of battle wounded men. Appendicitis, hernia, cholelithiasis, urinary retention, mastoiditis, bone tumors and cysts and stomach ulcer bleeding or perforated appear with the mass of other material and diagnosis must be as keen and prompt as under other conditions. We found it possible to do the cleaner and aseptic surgery on cases demanding it although we also dealt with so much sepsis. I still remain to my mind the anesthetic of choice for serious operations.

I take advantage of this opportunity to thank the members of the Chicago Medical Unit, British Expeditionary Force for their co-operation and to express regret that the Unit ceased to exist because we were unable to obtain reinforcements.

ODONTOMATA<sup>1</sup>

WITH SPECIAL REFERENCE TO THEIR CLASSIFICATION

BY CHARLES W. BONNEY M.D. AND A. G. ELLIS M.D. PHILADELPHIA

THE histories of the cases upon which Doctor Ellis's pathologic report is based are as follows:

The patient from whom the larger of the two tumors was removed was a middle-aged colored woman who stated that to the best of her recollection the trouble in her lower jaw began about fifteen years prior to the time she consulted me. Upon several occasions punctures had been made into the growth through the mouth, and some fluid evacuated. Marked increase in the size of the tumor had taken place within the last two or three years. Her chin and the left side of her face along the alveolar process of the jaw were very much enlarged and the floor of the mouth was almost entirely obliterated. At first sight she looked like a person who had acromegaly.

The operation, which was done under ether narcosis, consisted first in making an incision within the mouth over the most prominent part of the tumor and then stripping back anterior and posterior flaps of mucous membrane after which the growth was broken into with a chisel and the evacuation of its contents both liquid and solid, and removal of its walls were begun. It was a multilocular cyst containing for the most part thick chocolate-colored fluid. As the wound thus made was found inadequate to effect sufficient removal of the diseased tissue a second incision was made at the junction of the anterior flap and the lower lip in such a manner that the soft parts covering the chin could be dissected free and turned down together with the lip like a curtain over the margin of the alveolar processes. This gave a sufficiently large field to remove the greater part of the cyst. However, some of the anterior wall was left in order to retain the normal shape of the chin. The cavity was lightly packed with gauze and the soft parts sutured into place. The patient became restless and left the hospital a few days after the operation. She was seen about six weeks later at which time the cavity in her lower jaw was very much reduced in size. Her appearance was much improved by the operation.

The other case was that of a woman who had been operated upon twice before the first operation having been done thirteen years ago by the late Dr. William J. Roe and the second one six years ago. There was a slight enlargement of the body of the left mandible, which was better outlined, however, by examining through the mouth. A portion of the tumor including both mucous membrane and bone was removed with the scissors and the con-

tents evacuated. The patient has not been seen since she left the hospital.

With reference to the different diagnoses given in the two cases in which Doctor Ellis has shown that the tumors were structurally identical I was under the impression that in the case of the colored woman I had to do with a tumor of more complex structure than the one in the other case. I thought that very likely the tumor might contain enamel and a greater proportion of other solid elements. Hence the clinical diagnosis of cystic odontoma. Inasmuch as Doctor Ellis has enumerated fifteen different names for this type of tumor it would seem to the clinician that any term he might apply to them would be little better than a guess.

There are two points which I wish to make with reference to neoplasms of this kind. The first is that they can almost always be attacked and successfully removed through the mouth, as it will usually be possible to displace the soft parts covering the bone and then suture them into place again after the tumor has been removed as was done in the case of the colored woman. The second point is that clinically these tumors are benign. In our second case Doctor Ellis found sections containing areas suggestive of epithelial infiltration. In a considerable number of cases in which similar microscopic findings were reported the late Dr. Roe had the opportunity of watching the patients for years and in not a single case did malignancy develop even though recurrence took place as it did in the case in question.

## PATHOLOGY

Odontomata are not rare tumors but the many views regarding their classification may justify a report of two cases. The different diagnoses from the gross appearance of these two specimens although microscopically the same in type, suggested in addition to a discussion of that variety a general review of

the classification of these tumors. To that phase of the subject therefore this part of the paper is largely devoted.

One of the shortest and best of the many definitions of the tumor under consideration is that of the Committee of the British Dental Association (1). An odontoma is a tumor derived from the special cells concerned in tooth development.

A brief description of those cells from which the teeth arise will help make clear certain statements regarding tumors originating there from. The epithelium lining the mouth cavity sends into the developing jaw an ingrowth the dental ridge or shelf. Into the under surface of this epithelial ridge at the site of each future tooth projects a mass of connective tissue cells known as the papilla. Between the indentations thus formed the epithelial cord later divides so that over each papilla is a separate mass of epithelial cells. Each of these spreads out over its papilla as a cap called the enamel organ. This organ (the epithelial portion of the tooth) has three types of cells: the inner layer next the papilla is of tall cylindrical cells (ameloblasts or adamantoblasts) that lay down the enamel; the outer layer is of low columnar or cuboidal cells; the bulk of the organ between these two layers is of cells connected by short processes giving them more or less of a stellate appearance that is often suggestive of myxomatous tissue. The papilla is the connective tissue portion of the tooth and from it develop the dentine, cementum and pulp. The fibrous wall surrounding all these structures is known as the sac or tooth follicle.

An odontoma therefore may arise from the enamel organ from the papilla from the tooth follicle or from the whole tooth germ depending upon which of these structures is concerned in producing the abnormal growth. This makes possible simple or complex tumors of varied structure epithelial or connective tissue or both in type. For these reasons the difficulties of classifying odontomata appear not less than those encountered in connection with tumors of other origin.

Most writers of recent years follow more or less closely the divisions given by Bland Sutton (2). He names the odontomata from

the part of the tooth germ concerned as follows:

- |   |                              |                         |
|---|------------------------------|-------------------------|
| 1 | Epithelial odontoma          | from the enamel organ   |
| 2 | Follicular odontoma          |                         |
| 3 | Fibrous odontoma             | from the tooth follicle |
| 4 | Cementoma                    |                         |
| 5 | Compound follicular odontoma |                         |
| 6 | Radicular odontoma           | from the papilla        |
| 7 | Composite odontoma           | from the whole germ     |

His description of the epithelial odontoma identifies it with what is called by some cystic odontoma and by others adamantinoma; the latter term being applied to the tumor because of its origin from the enamel organ. Besides these more common terms many other names have been given to this type. Bland Sutton believes that many tumors of the jaw reported as belonging to this group are really endotheliomata. He also asserts that the term dentigerous cyst should be replaced by that of follicular odontoma.

Scudder (3) defines an odontoma as a tumor of the jaw arising from a portion of a tooth's follicle. He uses the term follicle to include the dental epithelium or enamel organ, the dentine papilla and the enveloping connective tissue sac that is the whole tooth germ. Other writers use the term follicle at least from the standpoint of its connection with tumors as synonymous with the third element only that is the fibrous sac enveloping the enamel organ and papilla.

Scudder regards Bland Sutton's classification as best but as including too many varieties for the convenience of the surgeon. He discusses the following as being of surgical importance:

- Dental root cyst
- Follicular or dentigerous cyst
- 3 Compound or composite follicular cyst
- 4 Adamantine epithelioma
- 5 Hard odontomata

The use of the last mentioned group (5) is believed to simplify the naming of these tumors and probably does from the surgical standpoint. Histologically it is quite indefinite. Scudder's description of the gross and microscopic structure of these five groups is in general quite satisfactory and his discussion of the embryology of the teeth explained by many illustrations is very clear.

Blessing (4) distinguishes between the adamantinoma and odontomata. He traces the origin of the latter from ectopic tissue between the tooth site and the mouth epithelium and says odontomata are tumors whose structure resembles dentine. His discussion of the subject is of little value.

New (5) in reporting 26 cases from the Mayo clinic, divides cystic odontomata into two groups: the simple cysts and the adamantinomata. The simple cysts are of two types: (A) those commonly called dental or root cysts; (B) those usually called follicular cysts. The term follicular cysts for the second type he regards as misleading because it implies, although not necessarily, that the cyst has developed from the follicle of a tooth. He considers that the term dentigerous cyst is used too loosely and does not employ it. His cases include 12 of type A, 6 of type B, and 8 adamantinomata. The discussion of New's paper showed there was no unanimity of opinion as to the value of his classification of the epithelial group of these tumors.

Hopewell Smith (6) adds the term "odontocoele" to the many names already employed, distinguishing between extracapsular and subcapsular types. Those who discussed his paper were almost unanimous in the belief that new terms only add to the present confusion. Most thought dentigerous cyst a better term than odontocoele. Bennett regarded the description of the extracapsular odontocoele as identifying it with a typical follicular odontoma.

In 1910 L. Esperance (7) reported 8 cases of adamantinoma from the Pathological Laboratory of Cornell University. In that laboratory they divided these tumors according to the type and arrangement of the epithelial cells into three groups: (1) acanthomatoid, (2) pleomorphic, (3) glandular. I can see only confusion resulting from the attempt to distinguish every individual peculiarity of a tumor by a separate name. It possibly had justification in this instance in connection with a feature emphasized by Dr. L. Esperance and in the discussion by Drs. Ewing and Kelly, namely, the metaplasia found in recurring tumors of this kind. One of their cases thus furnished 5 specimens; the diagno-

sis in some being in doubt and the histology ranging from that of epithelioma to spindle cell sarcoma and perithelioma. This feature may underlie Bland Sutton's opinion that many endotheliomata have been called odontomata. Ewing characterized the metaplasia in these tumors as unusual and a fact that must be recognized if one is to be a safe diagnostician in such cases. He again refers to this case in a recent discussion of tumor transformation in experimental cancer research (8).

Mallory (9) following his method of naming tumors speaks of tumors of the enamel organ as adamantoblastomata. He recognizes three types of tumors arising from the enamel organ: (1) the follicular cyst, (2) the adamantinoma, (3) no distinct italicized name as in the first two is given for the third type. The statement is made that the adamantinoma occasionally produces typical enamel but more often converts adjoining fibroblasts into odontoblasts producing separate or fused teeth (odontoblastoma). This third type of Mallory I do not understand. Odontoblasts are the superficial cells of the papilla, or connective tissue portion of the tooth, and produce dentine; why this process should be discussed as a type of tumor arising from the enamel organ is not clear.

In addition to the cysts forming in the enamel pulp of adamantinomata, Mallory describes cysts which may be more numerous and larger than those that develop in the connective tissue of the stroma as the result of focal collections of fluid. In the latter type the nuclei of the epithelial cells are in the portion of the cell farthest from the cyst, in the former they are nearest the cyst cavity.

Dean (10) in reporting a compound follicular odontoma of the superior maxilla in a girl of 20, accepts the classification of Bland Sutton.

Bland Sutton (11) reports a case of radicular odontoma in the lower jaw of a man of 62; thus he emphasizes as an unusual age. He states that odontomata have been so carefully studied that they are now the most complete tumor group known to pathologists. This may be true as a general statement but certainly does not appear to be so as to details and classification.



Stumpf (12) in 1910 reported an adamantinoma of the upper jaw and refers to several others that had been reported although these tumors are much more common in the lower jaw. This is the first case in German literature in which the growth extended into the antrum of Highmore. It also involved the nose. He states that one can speak of solid cystic and multilocular adamantinomatous. The solid represents an early the cystic a later stage of the growth. The multilocular is also solid in the early part of its course.

Lewis (13) reports three cases of multilocular cysts of the jaws. One tumor was the size of an orange with most of its septa entirely fibrous a plate of bone being only occasionally present. A second tumor contained neither bone nor cartilage in the sections examined.

Fischer (14) reports what he regards as a primary adamantinoma of the tibia in a man of 37. Swelling appeared four months after he had fallen and struck the tibia on the edge of a stair. The tumor was the size of a hen's egg. Resection of 8.5 centimeters of the tibia with bone implantation was performed. Fischer furnishes many illustrations to show that the tumor arose from misplaced rests of enamel organ. The findings were entirely against its being a metastasis of a jaw tumor. The possibility of its being an endothelioma is discussed by Fischer and excluded.

If this tumor were really an adamantinoma it would seem to be unique in literature. Many if not all of the adamantinomatous of the jaws are supposed to arise from retained rests of the enamel organ the prurulent epithelial debris of Malassez near the teeth. I do not know of a case other than that of Fischer in which they have been supposed to occur in other parts of the body.

The most carefully considered and elaborate discussion of odontomata is that of Messrs. Gabell James and Payne a Committee appointed in 1907 by the British Dental Association to consider these tumors. Their report (1) published in 1914 contains the clinical and pathological description of scores of tumors collected as a display at one of the meetings of the association. The committee finally adopted a classification based upon

but considerably modifying that of Bland Sutton. Because of the limited circulation of this report the classification of the committee with general descriptive points is here given in full. (The Committee uses throughout the term odontome instead of odontoma.)

*Epithelial odontomas* Where the abnormal development takes place in the dental epithelium alone

- Multilocular cysts
- Dentigerous cysts
- Dental cysts

*Compound odontomas* Where the abnormal development takes place primarily in the dental epithelium and secondarily the dental papilla and may occur in the follicle also

Where the abnormal development of the dental epithelium is such that the formation of numerous regular dentine papillae results which are calcified in mass or sporadically

- Compound odontomas
- Compound odontomes

b Where the abnormal development of the dental epithelium is such that the formation of two or more toothlike dentine papillae results and are calcified as one mass

- Geminated compound odontomes
- Geminated compound odontomes
- Enamel nodules

Where the abnormal development of the dental epithelium is such that the formation of a dilated portion of the dentine papilla results and calcified as one mass

- Dilated compound odontomes

3 *Connective tissue odontomas* Where the abnormal development takes place in the dental tissues of mesoderm alone

- Fibrous odontomes
- Cementomes

This classification like all others is of course open to criticism and objection. A very instructive discussion of it is given editorially in the *British Medical Journal* (16). With its descriptive statements this method of division forms an admirable basis for a study of the real nature of these tumors even if one does not entirely agree with the naming of the varieties. The report as a whole with the descriptions of the many tumors included and the numerous illustrations is a most valuable addition to the literature on odontomata.

The various methods of classification here reviewed show something of the different views held as to the naming of these tumors. A summary of the subject especially including details of the epithelial group can best be given after consideration of the specimens forming the basis of this paper.

The larger of the two tumors furnished me by Dr Bonney was an irregular dark reddish mass of tissue 2 by 3 centimeters comprising this main part of the tumor was a very thin plate of bony tissue 3 centimeters wide and several very small fragments resembling the larger mass. In the largest piece on section could be seen several small cysts. The clinical diagnosis was cystic odontoma.

Microscopically the coarse stroma of the tumor is largely of osteoid tissue. This is in bands of varying width and at points are lamellae suggestive of haversian systems. In places are broad bands of connective tissue in addition to or instead of the osteoid structure.

Between the stroma like masses of osteoid tissue are islands of dense or moderately cellular connective tissue in which are nests or cords of epithelial cells (Fig 1). The peripheral layer next the enclosing stroma of many of these cell masses is cylindric in type. These cells have round or oval nuclei placed nearer the inner than the outer extremity of the cell (Fig 2). In some instances the peripheral layer is less tall and the nuclei do not have the polar position. The central part of each small cell mass is made up of round or moderately elongated cells. In the larger and evidently older cell collections a distinct change takes place in the central cells. Many of them are elongated or actually flattened in shape the cytoplasm is more abundant and slightly basophilic in reaction. Between many of these cells especially those not so markedly elongated are cytoplasmic bridges giving a stellate outline to the cells and forming a network between them. (This is particularly characteristic of the enamel organ.)

In a more advanced stage the flattened cells assume a concentric arrangement giving in some instances a striking resemblance to the pearl seen in epidermoid cancers (Fig 3). The cells in the center of these concentric masses or even where that arrangement is not pronounced become less prominent stand less deeply seem to fuse and finally reach an advanced stage of granular degeneration and disintegration (Fig 4). As a result of this there are formed small spaces either



Fig. 1. Portion of odontoma under low magnification to show general structure of tumor. a Dense connective tissue bordering growth. b groups of epithelial cells resembling more or less closely the enamel organ. c one of the pearl like masses of degenerated epithelial cells (area within circle shown by higher magnification in Fig. 3). d connective tissue stroma.

empty or partly filled by granular debris these being bordered by the elongated or flattened cells previously described (Figs 5 and 1). As the spaces become larger and assume actual cyst form these flattened cells are crowded against the peripheral columnar layer the two together forming the wall of the cyst (Figs 6 and 7). In some of the larger cysts this flattened cell layer becomes extremely thin or disappears but none of the cysts I have seen lacks entirely the peripheral columnar layer. (New describes its disappearance in large cyst.)

Most of the individual cell masses and cysts are surrounded by a narrow zone of connective tissue more dense than that of the intervening portion. In isolated areas of the connective tissue are small hemorrhages unaccompanied by necrosis. The mucosa of the gum where present over the tumor is intact.

In addition to this tumor Dr Bonney had previously given me a small piece of tissue 1.5 centimeters long as a specimen of dental cyst. The general structure of this tumor is essentially the same as that of the one described although no osteoid tissue is found

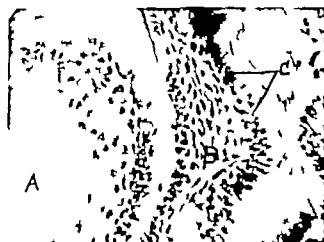


Fig. 1. Low magnification view of the tumor showing the transition from the normal epithelium (A) to the tumor (B). The tumor is composed of nests of cells with hyperchromatic nuclei and increased mitotic activity.



Fig. 3. Micrograph showing nests of tumor cells (B) and normal epithelium (A). The tumor cells are arranged in nests and show hyperchromatic nuclei and increased mitotic activity.



Fig. 4. Micrograph showing nests of tumor cells (B) and normal epithelium (A). The tumor cells are arranged in nests and show hyperchromatic nuclei and increased mitotic activity.



Fig. 5. Area of tumor showing hyperchromatic nuclei and increased mitotic activity (B). Part of the tumor is shown in the inset.



Fig. 6 Well advanced cyst. The cavity is partly filled by granular debris. It is bordered by a thin layer of extremely flattened cells which for a part of the circumference are in contact with the outer columnar layer.



Fig. 7 Higher magnification of the wall of a cyst similar to that shown in Fig. 6. The cavity of the cyst containing granular debris forms the lower part of the figure. Above this are the flattened cells just within the external layer of columnar or cuboidal cells.

in the septa. The stroma consists simply of bands of connective tissue variable in width, mostly rather narrow. The peripheral layers of epithelial cells are columnar but not so many of them distinctly of the adamantoblastic type as in the first specimen. Concentric arrangement of cells is in places well marked. Cyst formation has occurred some of them being larger than those in the other specimen. At points the peripheral cell masses have an appearance and relation to the surrounding connective tissue very suggestive of carcinomatous infiltration.

These two tumors therefore very clearly belong to the same group: epithelial odontoma. They well illustrate the difficulty in deciding upon the exact type of the tumor by the gross appearance, one being sent to the laboratory as a cystic odontoma, the other as a dental cyst. According to the classification of the British Dental Association both specimens should have been called multilocular cysts, as they do not use the term cystic odontoma. Neither do they employ the

term adamantinoma as used by New and many others to designate tumors of this type, namely those formed from the enamel organ. If this name be employed both our specimens are adamantinomata.

Combining the lists of synonyms given by various writers we have the following names that have been used for tumors possessing the structure described: epithelial odontoma, cystic epithelioma, multilocular cystic epithelial tumor, adamantine epithelial tumor, adamantinoma, adamantoblastoma, cystic carcinoma, adenocarcinoma, adenosarcoma, multilocular dentigerous cyst, cystadenoma of jaw, fibrocystic tumor of jaw, cystic sarcoma, cystic adenoma, proliferating follicular cystoma. Of the adamantinoma these sub-varieties to indicate individual peculiarities have been named: solid, cystic, multilocular, xanthomatoid, plexiform, glandular.

The classification of odontomata as adopted by the British Dental Association is probably the best but it differs in two respects from that of many other writers. First it does



## TUBERCULAR CERVICAL ADENITIS IN CHILDREN

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AS the result of clinical experience bacteriological and pathological research combined with comprehensive studies of the occurrence and spread of the disease tuberculous cervical adenitis has become one of the best defined affections of childhood. Among the non contagious diseases of children the high occurrence of the affection and its sectional prevalence have been factors precipitating far reaching investigations upon etiology and prevention such as the great Edinburgh report toward which Mitchell Woodhead Deslepine Stiles Raw and others contributed classical studies.

Very few American writers have driven home the fact of occurrence with the same emphasis as the foreign investigators. In considering the prevalence of tuberculous glands among children few realize the predominance of this form of tuberculosis. At the Sixth International Tuberculosis Congress Karlson of Stockholm reported from the examination of more than fifteen thousand school children that nearly ten thousand had early glands and of this number from 10 to 30 per cent had definite or present tuberculous glands. On the other hand only 1.60 per cent of the children had lung tuberculosis and those with bone and joint affections were but 0.57 per cent.

Raw finds that in countries where cow's milk is not drunk surgical tuberculosis does not exist though phthisis is common and considers that tuberculosis from the bovine and human bacillus are of perfectly distinct and different types. How the figures in this community would compare with those of Karlson I do not know, but it is certain that tubercular adenitis is much more common in children than adults and that the glandular infections are probably more common than the pulmonary in children.

The probability of most of these being of bovine origin has awakened the public to the advisability of a non tubercular milk supply.

To universally procure such still requires plenty of work on the part of the medical man and hygienist in co operation with the boards of health and legislatures. In the meantime treatment and the end results to be expected from surgery are perhaps the most important aspects of the disease.

To the most effective surgical treatment an early diagnosis of tuberculous glands is of great importance and except to the physician of considerable experience early diagnosis presents certain difficulties in differentiation from other cervical lesions of somewhat similar appearance.

Tuberculous cervical adenitis is always secondary to some portal of entry the commonest of which is the tonsil those of rarer occurrence being the adenoid tooth ear or skin of the face or scalp. The appearance of the primary focus may be useful as an aid to diagnosis when such a focus occurs in the skin. For instance the characteristic appearance of the lupus makes it logical to conclude that the enlargement of glands draining this area is of a tuberculous character also.

The portal of entry however is rarely such a landmark and by far the commoner method of arriving at the diagnosis is to draw conclusions based upon experience of the general symptoms signs and appearance of the glandular swelling and then from one's knowledge of the distribution of the lymph vessels conclude what is the portal of entry. Glands lying closely under the body of the jaw in which there is a carious tooth point very conclusively to the tooth as the portal of entry but the surgeon is dependent upon the feel appearance and action of the glands for his diagnosis of tuberculosis and not on any peculiarity of the carious tooth. In the vast majority of cases which one sees the glands affected are those under the angle of the jaw the glands which drain the tonsil but here again the diagnosis must be made from the glands. The tonsil has no gross appearance upon



Fig. A. Large mass of tubercles in the tonsil. The tubercles are arranged in a somewhat circular pattern, with a central area of necrosis. The surrounding tissue is highly cellular and shows signs of inflammation.

which the diagnosis of tuberculosis can be made. This fact was demonstrated two

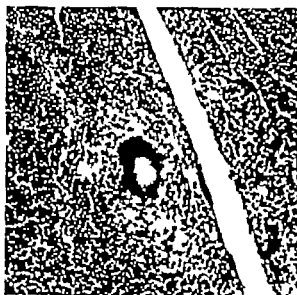


Fig. B. Larger mass of tubercles in the tonsil. The tubercles are arranged in a somewhat circular pattern, with a central area of necrosis. The surrounding tissue is highly cellular and shows signs of inflammation.



Fig. C. Tubercle in the tonsil. The tubercle is arranged in a somewhat circular pattern, with a central area of necrosis. The surrounding tissue is highly cellular and shows signs of inflammation.

years ago in a study of the tonsils as the major portal in my own cases which was undertaken with Dr. Karsner. Histological examination showed the presence of tubercles in the tonsils which could not be diagnosed as tuberculous from clinical examination of the throat. The distribution of tubercles as seen in the accompanying microphotographs (Figs. A, B, and C) suggests strongly that the tubercle bacilli gain entrance to the tonsil through the crypts and also shows from the proximity of the tubercles to the capsule the necessity of removing the capsule with the tonsil if one wishes to eradicate the disease. I have had demonstrated with the microscope tubercles in tonsils of the large protruding type as well as in those buried in the fauces and believe it is as impossible to tell which tonsil may be harboring tubercles from inspection as it is manifestly impossible to see the tubercles themselves. Tuberculous ulcer of the tonsil is an entirely different pathological condition and one which I have never seen associated with tuberculous cervical adenitis in childhood.



Fig. 1. Early tuberculous cervical adenitis.



Fig. 2. Same case as Fig. 1 after removal of glands. Note the inconspicuous scar.



Fig. 3. Inconspicuous scar following removal of tuberculous glands at an advantageous time.



Fig. 4. Same as Fig. 3 to show how scar cannot be seen from in front.

Tuberculous glands of the neck in the early stages are discrete, freely movable and lack any of the local or general characteristics of acute inflammation. The patients as a rule have no elevation of temperature and other than a characteristic placid appearance easier to recognize by one who has seen a large number of these cases than to describe show no general manifestations of the disease. In this early stage when the gland under the angle of the jaw has attained the size of a filbert or is perhaps still smaller a negative von Pirquet reaction is of value in ruling out tuberculosis. A positive von Pirquet is of little or no value as such a large proportion of children give positive reactions anyway. Failure of the glands to disappear following tonsillectomy is a positive indication of their being tuberculous in nature or at least something more than simple chronic hypertrophy. Figure 1 shows a tuberculous adenitis in its early stage when the diagnosis should be made and when the removal of the glands can be performed with confidence as to a permanent cure and with a very inconspicuous scar. (See Figs. 2, 3 and 4.)

The infected glands untreated increase in size and number in an irregular manner. They may enlarge rather rapidly for a week or two then remain quiescent or even decrease sometimes for quite a long period of time only to increase again later. The most superficial gland usually increases more

rapidly than those underlying it and frequently becomes adherent to the skin and the underlying glands. Later groups of glands coalesce forming large irregular masses (see Fig. 5) the most superficial part of which may be fluctuant while the deeper parts remain hard and nodular the whole presenting a very characteristic appearance resembling no other condition closely. Rarely the glands break into one another forming a large mass the whole being surrounded by a dense fibrous capsule (see Figs. 7 and 8) and allowing one to remove the whole *en masse*. Such cases resemble sarcoma more closely than the commoner variety of adenitis but the course of the disease is quite different. The sarcoma develops more rapidly and more regularly has on palpation a firmer and more solid feel and when it has reached a large size frequently becomes marked by prominent superficial veins.

The glands of Hodgkin's disease though sometimes limited to one side of the neck at the start usually soon become more general in distribution involving both sides of the neck, the axillæ and groins. Hodgkin's glands remain discrete not coalescing even when attaining very large proportions and do not become fixed or adherent from periglandular inflammation.

Enlarged glands of syphilitic origin are of rare occurrence in children and can be distinguished by other manifestations of the disease. Branchial cysts or thyroglossal





Fig. 7. Frontal view of patient showing the location of the parotid gland and the incision site for its removal.

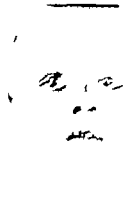


Fig. 9. Frontal view of patient showing the location of the parotid gland and the incision site for its removal.

duct usually have to be considered in the diagnosis but their anatomical situation, their occurring singly and their appearance usually makes them easy to differentiate.

The time at which operation should be performed is of such importance that the more difficult diagnosis should be left to the surgeon whom experience has trained to make definite associations between the conditions based at operation and the clinical examination.

For tubercular glands arising from the skin of the face or scalp from the ear, tooth or nose, a special operation is required for each individual case according to the position of glands and the amount of involvement. But a very large majority of the cases seen have the tonsil for the portal of entry and involve the glands under the angle of the jaw first. For this typical group of cases the tonsils should always be removed and in very early cases if there is doubt about the diagnosis the glands may be left alone for a short time until the diagnosis is established. Care should be taken however not to wait long enough for the glands to break down and result in abscess which increases the difficulty of operation and endangers the good results.

In typical cases involving the glands draining the tonsils the operative technique here is quite similar to that employed by

Dowd. A transverse skin incision is made in one of the natural folds of the neck one or two fingers breadths below the body of the jaw and extending from the posterior border of the sternomastoid muscle as far forward as need be. The length of the incision is dependent upon the size of the gland to be removed. After incising the skin the platysma muscle is cut across the anterior border of the sternomastoid identified and the glands exposed in the superior carotid triangle. The most superficial gland usually shows more advanced caseation and liquefaction than those underlying it and care should be taken to avoid rupturing it. But if a nick is made in it and some caseous pus spalled it does not mean that the dissection should be necessarily abandoned the pus may be sponged out with dry gauze, the wound wiped with tincture of iodine and the dissection continued. All layers of the upper side of the wound to the deep cervical fascia are now retracted upward including in the retraction the lowest branch of the facial nerve and the dissection is carried inward until the posterior belly of the digastric muscle comes into view. The anterior border of the mass of gland is freed until the facial or internal jugular vein is exposed. The glands are then retracted backward and loosened by blunt dissection until the spinal accessory nerve is identified and exposed to its point of entrance into the sternomastoid.

muscle This group of glands are now removed leaving in view in the wound the anterior border of the sternomastoid the posterior belly of the digastric, the facial and internal jugular veins and the spinal accessory nerve The group of glands lying behind the spinal accessory nerve and sternomastoid muscle are next removed and then those following the course of the internal jugular vein In cases where the dissection is very difficult and the glandular involvement very extensive a second incision may be made below and parallel to the first, or a vertical incision behind the sternomastoid joining the posterior end of the first incision (see Fig 6) Such procedures however are necessary only in neglected cases which come to the surgeon late All visible and palpable glands having been removed a small opening is made behind the sternomastoid for drainage the wound is wiped out with half strength tincture of iodine and the incision closed by suturing the platysma with interrupted catgut and the skin with intracuticular silk worm gut suture If the patient's condition warrants it at the end of the dissection in the neck if the tonsils and adenoids have not already been removed they are now enucleated If at the end of the dissection the patient's condition does not warrant a tonsillectomy this may be performed two weeks or so later It has been said that removal of the tonsils at the same sitting as glands of the neck prevents primary union of the wound but this has not been my experience practically all cases operated on at an advantageous time healing *per primam* In cases where the glands have broken down so far as to form an abscess and where the periglandular inflammation is so marked as to obliterate all lines of cleavage a dissection is out of the question In such cases a comparatively small incision should be made the cavity curetted of as much necrotic material as safe and then wiped out with tincture of iodine This procedure is curative only for those cases of superficial abscess without underlying glands a condition occurring rather rarely For the cases with underlying gland the incision curetting and drainage of abscesses results in sinus formation the

glands beneath breaking down one after another and keeping up the discharge sometimes for months or even for years unless further operative treatment is instituted When a sinus has reached a comparatively quiescent stage it is safe and advisable to excise it and dissect out the glands beneath, which will effect a cure The wounds resulting from operations performed under these conditions heal by first intention surprisingly often and when they do not are practically always healed at the end of two or three weeks a status far more desirable to both patient and surgeon than a discharging sinus for two or three years The after care consists in removing the small drain at the end of forty eight hours keeping the patient in bed for two or three days and in the hospital about ten days then providing nourishing food a non tubercular milk out door life as much as possible and in general good hygienic conditions

During the past five years I have operated on 159 cases of tuberculous cervical adenitis at the Children's Hospital and in private practice Of these the end result has been ascertained at periods of time varying from six months to five years in 130 cases Of the remaining 29 cases two are dead and 27 either have been lost track of or have been operated on too recently to make an opinion of the result valuable Of the two deaths one occurred six months after the operation in a child who had done very well and shown no evidence of either local or general recurrence of the tuberculosis but who was taken with lobar pneumonia from which she died This death cannot in any way be connected with the operation or have any particular bearing on the fact that the child had had previously a tubercular adenitis The other death occurred in a child in whom the diagnosis of meningeal tubercle with recovery had previously been made She presented a large mass of broken down glands and an attempt was made to dissect them out She died three days after the operation with a very high temperature and meningeal symptoms This operation was performed some four years ago was probably ill advised and is the only operative death which has

occurred in this series of cases. In the other 130 cases excision of all palpable glands with two exceptions in which excision was somewhat limited by special conditions was practiced 119 times the results of which are considered later. Incision of tubercular abscesses followed by curetting and wiping the cavity out with gauze and tincture of iodine was the operative procedure 11 times. Of these eleven patients followed 5 have been apparently cured while 6 still presented evidence of active tuberculosis when last examined and in them the following points are of interest and worth mentioning:

**CASE 2.** Tubercular adenitis of two years duration for which excision as advised. Child a condition under either did not warrant a dissection so incision curetting of the glands which were most broken down was practiced. Sinus formation lasting for weeks followed X-ray treatment tried. One year later number of glands present on both sides of neck. General condition poor.

**CASE 3.** Persistent glands for one year. General medical treatment for same period. Entered hospital with glands on both sides and abscess condition such that excision was infeasible. Following incision operation sinuses persisted for one year in spite of excellent hygienic treatment and X-ray treatments for six months. Further operation necessary for a cure.

**CASE 3.** Glands of nine months duration. Tonsils and adenoids removed a year before entry. Sinus persisted eight weeks following incision and a year and one-half later glands still persisting. Further operation advisable.

**CASE 4.** Child three months. Both sides of neck involved and both sides incised. Tonsillectomy advised but not performed. Two years later child reported with considerable glandular involvement. Then lost track of.

**CASE 5.** Tubercular abscess discharging for five weeks. Tonsillectomy a year previously. Canine teeth present. Five months after incision sinuses persisting. Advice about cure of teeth not followed.

**CASE 6.** Glands of months duration. Followed usual course in spite of tuberculin treatment in good hands and the best of hygienic treatment. Incision and curetting of tubercular abscesses. Small sinuses six months later still persisting.

In the 119 cases in which excision of all palpable glands with the portal of entry was attempted 111 or 93 per cent have shown no palpable glands or evidence of tuberculosis at examinations made from one to five years after operation. In 93 the wound healed by

primary union giving an almost immediate as well as a permanent good result. The 24 cases in which union was secondary were without exception cases in which the tuberculous process was far advanced and in which incision into abscesses had been restored to before excision was accepted by the parents or possible to the surgeon. In the majority of these cases even the wound was healed inside of three weeks.

Of the 8 cases in which palpable glands of significance appeared after operation in 3 the glands were on the opposite side of the neck. One had the tonsil removed on the side of the original glandular involvement only and the occurrence of glands on the opposite side requiring a second operation might have been avoided had both tonsils been removed at the first operation. In one case in which an excision was performed on one side of the neck and an incision of the other a recurrence or persistence exists on the incision side. In a third case glands appeared on the opposite side of the neck along with a tubercular keratitis. The persistence in 2 other cases is coincident with secondary union of the wound and other tuberculous lesions one bony the other glandular in the groin. In 2 cases failure to remove the tonsils is probably responsible for the occurrence or persistence of the disease. In the 1 other case there is only a very small gland present which probably has no clinical significance but as there is a question of pulmonary involvement it has not been classed among the apparent cures.

From analysis of these cases it is seen that failures of cure can usually be attributed to failure to remove all tuberculous tissue or to overlooking the portal of entry. Sometimes that is the fault of the surgeon's judgment in not recognizing the importance of the primary focus and sometimes it is the fault of the parent or medical adviser in not recommending operation at a time when it is feasible to perform a clean dissection. The percentage of these failures is however small and in marked contrast to the results to be expected from incision and drainage operations. Though in this series of cases but 11 results from the incision operation have

been presented 41 of the dissection cases had had one or more palliative operations before being referred to me for excision. These cases have given ample opportunity for observation of the conditions following palliative operations and have clearly demonstrated the undesirability of postponing surgical intervention until abscess drainage becomes a necessary preparation for an excision operation.

In 34 patients having persistent sinuses coming for radical operation the duration of the unsuccessful treatment varied from one month to more than four years. In 2 the sinuses had persisted for thirteen and twelve months respectively in spite of tuberculin and hygienic treatment. In 3 the sinuses persisted for thirteen, eleven and six months in spite of tuberculin and X ray treatment in the first and X ray treatment alone in the other 2. The other 29 cases had had one or more incisions and some of them had excellent out door hygienic treatment as well. The average duration of the sinuses in those 34 cases was ten and one half months before the operation for removal of the glands was performed. How much longer the sinuses would have persisted without the more radical operation being performed of course it is impossible to say. Likewise it is difficult to tell how many of these patients would have eventually recovered or in how many the disease would have gone to other parts of the body. Probably many of them would have eventually recovered but only after a long and tiresome siege of frequent dressings.

#### CONCLUSIONS

From study of the literature and from my own experience the following conclusions seem justified. That tuberculous cervical adenitis is a very common affection of childhood. That further investigations should be undertaken to establish more definitely the question of the disease originating from the bovine or human type of tubercle bacillus. That if it becomes firmly established that milk is responsible for the major number of the infections it would seem possible to reduce greatly their frequency by securing non tubercular milk supplies. That

some children suffering from this disease recover by other forms of treatment than radical surgery but only after long periods of time. That from my own experience and that of Dowd and many other surgeons radical operation including the removal of the portal of entry is by far the surest and safest method of obtaining a prompt and permanent cure. That when the operation is performed before the glandular involvement becomes very extensive it need leave only a very inconspicuous scar. That over 90 per cent of cures resulting makes the operation one of the very satisfactory procedures of surgery.

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SYMPOSIUM ON EXPERIMENTAL SURGICAL STUDIES<sup>1</sup>FROM THE DEPARTMENT OF SURGICAL RESEARCH UNIVERSITY OF PENNSYLVANIA  
SCHOOL OF MEDICINE

- I SURGICAL RESEARCH OF THE GREAT OMENTUM
- II RECENT EXPERIMENTAL STUDIES OF THE PANCREAS
- III TRANSPLANTATION OF THE URETERS INTO THE INTESTINES
- IV EXPERIMENTAL STUDIES IN COLONIC DILATATION

## SURGICAL RESEARCH OF THE GREAT OMENTUM

BY S L BLOOMHARDT C F ANDREWS R R HETHERINGTON

THE great omentum has been the subject of medical interest and research for more than 3 600 years yet in this present era of scientific enlightenment it is still an organ of much mystery. It has been worshiped and relied upon by the surgeons of the past and of the present and it is our purpose in this paper to present you with data which we hope will lead surgeons to rely more upon it in the future.

Dr John G. Clark in his lectures calls the omentum the policeman and the philanthropist of the abdomen. Dr John B. Deaver says to his mind it is more like a fireman who hears the first alarm and hastens to the scene with the necessary means to smother the flames. It wraps itself around inflamed areas protects against slow perforations walls off purulent collections and aids in absorption and exudation.

Thus you see the tribute the present day surgeons pay to this serous apron and you wonder that during the whole of the nineteenth century so little attention was paid to it. There is a scanty literature on the pathological conditions of the organ mainly on cysts and tumors of the same. This with a few papers on its development and still fewer upon sundry points of its histology with practically nothing upon its physiology represents as nearly as we can ascertain all that has been written during the past century. However the inquiring minds of progressive surgeons who explore many abdominal cavities both physiologic and pathologic along with the establishment of more modern research work has forced a

study of this important structure and brought to light many of the hidden functions and pathologic conditions of this hitherto neglected member.

And so if following the time honored custom one wishes to lead gently up to the subject by referring to observations and conclusions of those who have gone before he finds himself confronted by the fact that with the exception of the past fifteen years there is little to be said unless he travels back through the centuries. So let us travel back to 3 600 years ago when we find that the cunning Egyptian priests told fortunes by the omentum indeed it is most interesting to know that the organ was named by them. Priests during the process of embalming the human body would examine the abdominal viscera and as this organ in particular was a mystery to them they used it for a gun and would tell fortunes by it and according to the purse that the relatives were able to pay by examination of the omentum would give either good or evil omen as to the hereafter of the dead. Thus the first part of the name (*omen*) and by adding the suffix *um* of the language it came to be called the omentum.

When we pass back to the limits of medical history strangely enough we find that old Hippocrates 460-385 B. C. noted that which was more nearly correct than any observations for long centuries following. In addition to his aphorism that if the omentum protrude it necessarily mortifies and drops off he makes a longer reference in his book *peri herniarum* which did time permit I would gladly read because

of its interesting nature and shrewd observations but the abstract of it in a sentence is that he thought that the omentum regulated the amount of fluid in the peritoneal cavity

After Hippocrates we find that we owe to Aristotle 384 322 B C the commonly accepted opinion that the omentum is formed of light membrane and so placed covering the intestines as to preserve the innate heat of the body Galen accepted and expanded this view He gives the case of a gladiator who having lost his omentum through a wound recovered from the injury but there after felt cold in his abdomen

John Meckell 1714-1744 practically exposed the nature origin and anatomy of the mesogastrium

Malpighi 1628 1694 considered the omentum as the cause of ascites and as a storehouse of fat Other theories as to it being the cause of ascites followed not worthy of note simply mystic imagination And as in the writings concerning other organs in historic times the omentum as the rest was made the text of numerous most wild discussions For example Fabricius (*ab Aquapendente*) well known for his discovery of the circulation held that it was the seat of those winds which so torture hypochondriacs Cordeus taught that it was a second stomach or food store from which the stomach again received the food when by him man was declared to ruminate like unto brute beasts

As to the anatomy suffice it to say that it is a serous membrane attached to the stomach and transverse colon hanging apron like from these structures It consists of four layers of peritoneum between which are found various structures arteries veins lymphatics nerves fat and fibrous tissue Taking the liver as a starting point the anterior layers of the omentum swing down in two folds until it reaches the stomach where it divides one layer going behind this organ and one in front At the inferior aspect of the stomach the layers reunite and dip downward toward the pelvis and then again swing to the transverse colon thus forming the four layers

To the naked eye the omentum is seen as a smooth and glistening membrane of peritoneum in which may be distinguished long

slender blood vessels The larger arteries are always surrounded by fat, giving the omentum a fenestrated appearance

Histologically the omentum consists of a serous membrane Except for a delicate layer of fibro elastic tissue which supports the mesothelium there is comparatively little framework with the exception of the blood vessels This fibrillar structure is made up of a delicate network of curly strands of fibro elastic tissue The covering of the stroma consists of endothelial cells

The arteries in the anterior leaflet of the omentum have their origin from the gastro epiploic arteries These dip downward in the anterior fold of the omentum and anastomose with those of the posterior leaflet which have their origin from the arteries of the colon These vessels are extremely slender and send off numerous tree like branches usually almost at a right angle to the main trunk The arteries are accompanied by veins Many avascular areas are found the tissue living by imbibition These areas correspond to the clear spaces seen in the fresh specimen They are scattered over the entire omentum and constitute from one half to three quarters of the free surface of the organ In cases of peritonitis the smaller blood vessels surrounding these areas become enlarged numerous buds are thrown out and in a very short time the previous avascular areas will be found to contain vast numbers of small vessels These vessels play an important part in the combating of infection While being extremely rich in blood vessels the omentum is nearly devoid of capillaries there being a direct anastomosis between the veins and arteries

In a general way it may be said that the chief lymph channels follow the larger blood vessels The smaller vessels are found penetrating the omentum in all directions On the surface there are openings which have some sphincter action and they lead to underlying lymph channels thus showing one of the many most remarkable points about this organ Numerous lymphatic glands are found at the upper border of the omentum The omentum is well supplied with nerves These nerves are derived chiefly from the

nerv trunks of the stomach and transverse colon. Ganglia are also seen.

Concerning the physiology of this all important viscus there has been much work done with a variance of opinions and results. However this paper would not be complete without a brief mention of the functions and a short sketch of a little of the experimental work done upon it. First concerning the movement. It has been claimed by many that the omentum has in itself the power of moving from one part of the peritoneal cavity to another basing this assumption upon the well known fact that the omentum is found adherent to inflamed structures or even blocking ruptured typhoid ulcers gunshot wounds etc. Morrison likens this movement to that of a jelly fish. However no muscular tissue has ever been demonstrated in the omentum except that found in the walls of the blood vessels therein. It is hard to conceive that it has any inherent powers of movement but rather from its peculiar shape it is easily moved about by the action of the intestines and as the result of intra abdominal pressure. Dr. Byron Robinson says it is like a floating cork in whirling eddies the cork will finally float in the most quiet area which in the case of the omentum is the focus of peritoneal infection.

It possesses a bodyguard of leucocytes which are ready at a moment's notice to move to a point of irritation to digest, imprison or sterilize the invader. In fact Norris claims that the chief function of the omentum is one of leucocytogenesis stating that he was lead to this view by a histological study rather than by the results of physiological experiments. Renzi and Boen noted in experimental work that the omentum will nourish viscera which have become detached from their pedicles finally absorbing these organs stating that no other abdominal viscus possesses the protective or preserving powers of this organ. The omentum will successfully close apertures in both viscera and abdominal parietes. Many such cases are reported two of which we have heard in our own surgical clinics this year and did time permit it would be highly interesting to cite these

cases. Dogs have been shot through the stomach with a .32 calibre bullet and the omentum would sometimes close the bullet hole so effectively that the dogs without surgical intervention would be eating and playing within a week. It is a movable buffer or padding material filling in temporary spaces in the abdomen. It is a peripheral lymph regulating organ however it does not seem specialized for this function any more than the mesenteron. Numerous experiments on dogs rabbits guinea pigs accompanied by careful microscopic examination seem to prove that the omentum is not a special arbiter of peritoneal tides but the function belongs more to the diaphragmatic peritoneum.

Thus you have heard a very brief sketch of the marvelous activities of this organ some little of the experimental work done upon it all of which goes together and raises the question in inquiring minds since the omentum is so valuable physiologically — what could one do with it surgically? With this in view we started experimental surgical work on dogs. It has been observed in all abdominal experimental work that practically every autopsy two to six weeks after operation showed omental adhesions to the wound of the visceral peritoneum except wounds of the stomach. In Dr. Sweet's autopsies on dogs alone omental adhesions to varying degrees have been observed in nearly 100 per cent of cases. Dr. Byron Robinson Chicago says Postoperative omental adhesions are always very numerous as has been demonstrated in many cases both in dog autopsies and on living and dead subjects. He found 75 per cent of subjects (both dog and man) presented postoperative omental adhesions either to the abdominal wall or to the point of operation on the viscera.

At the present day there is no known way of preventing adhesions and since they cannot be avoided and do occur in a large percentage of cases a logical procedure it seems to follow would be to use the omentum in such a manner that it would be of practical value. In fact it should be borne in mind that the healing of wounds is essen-

tially a process of adhesion formation—a pouring out of lymph the coagulation of the same and its later organization therefore the absolute prevention of adhesion would likewise prevent wound healing

Our first set of experiments consisted in taking different portions of the gastro intestinal tract and making perforations in the same then overlapping the great omentum suturing it lightly to the gut wall. The immediate object being to find out in just what manner the perforation would be taken care of if taken care of at all how large a perforation we could make and to observe if any untoward symptoms would develop realizing that if in repeated experiments the omentum would satisfactorily take care of these perforations there are many surgical instances where it could be used. To make the perforations we used graduated cork borers. We took a series of three dogs making perforations in both the jejunum and ileum measuring from 1 to 2.6 cm. The omentum was folded 3 times over these perforations and sutured with silk. All the dogs made uneventful recoveries evidencing no signs of peritonitis or obstruction. At autopsy adhesions at the site of perforation were found the wound of the mucosa showed more as a dimple than as a scar. Grossly it is easy to recognize an overgrowth of mucosa covering the perforation. On the fourth dog we resorted to bolder measures trimming away the gut with scissors until there was only about 1 cm. of intestinal wall remaining where the mesentery was attached. The length of the opening was 3.5 cm. In this instance the omentum was thrown clear around the gut and sutured and then sutured to the edges of the perforation. The dog showed no signs of peritonitis whatever. At autopsy we found the omentum adherent to but one area of the gut, this corresponding to a defect in the mucosa which was linear and Y shaped. There were no signs of peritonitis or obstruction.

The next experiment was done on the stomach, the perforation being made on the anterior wall of the antrum measuring 1.8 cm. This was covered with two layers of omentum held by a circular layer of sutures. The

dog died the following morning from peritonitis. A defect was found in the covering of the omentum over the perforation showing plainly an error of technique on our part, in not being sure of the placement of our sutures. We repeated the experiment in exactly the same manner. The marked peristalsis of the stomach tried again to force the opening out from beneath the omentum during the operation hence it is reasonable to assume that this was the cause of the imperfect suturing in the preceding animal. This dog made a complete and uneventful recovery.

Following this we perforated the pyloric end of the stomach making an opening of 2 cm. As before this dog showed no ill effects of the procedure. Autopsy showed the omentum adherent to the site of the perforation and the interior of the gut presented a typical stellate scar.

We next assailed the colon a perforation measuring 2 cm. was made. In this case we encountered two difficulties the colon was distended with fecal material and the omentum was unusually small. The omentum was sutured over the perforation as before. The animal died that night of peritonitis and autopsy revealed imperfect closure of the hole by the omentum, fecal material escaping at the lower pole, again showing a faulty technique on our part. We repeated the experiment on another dog. In this case the animal did not even become sick and made the usual uneventful recovery.

In the next set of experiments on five dogs an end to end anastomosis was done omitting the Lembert seroserous stitch and rapidly approximating the gut with through and through sutures then placing the omentum around the wound putting in several sutures through the mesentery to hold it in place. All five dogs made complete recoveries. Autopsies on these dogs showed a perfect anatomical anastomosis in each case. At the site of union the omentum was found wrapped around and adherent to the gut. In two instances adhesions were found between two adjacent loops of gut forming a broad U with, however not the slightest evidence of any obstruction.



The omentum not having failed us thus far we proceeded to place still greater burdens upon its shoulders. We cut off the blood supply to varying lengths of gut by ligation of the main mesenteric vessels and of the arcus intestinalis. Having done this we overlapped with omentum the area to which the vascular supply had been cut off. Our immediate object was to discover if the omentum would take care of a gangrenous area if gangrene should ensue or whether it would entirely prevent the occurrence of a gangrene. We took a series of four dogs cutting off the blood supply from areas of gut varying in length from 6 to 16 cm. The omentum was doubled and placed around the gut holding it in place by sutures through the mesentery only that is no omentum was sutured to the gut itself.

Following operation there were no signs of gangrene intoxication or peritonitis all the dogs making complete recoveries. The autopsies showed extensive adhesions of the omentum around the gut and upon opening into the lumen of the bowel absolutely no indication of damage could be found. Microscopically no new blood vessel could be demonstrated to have grown from the omentum to the gut. The existing omental vessels were very numerous and greatly distended especially the veins denoting passive congestion and added function of these vessels. There was absolutely no evidence of gangrene.

Possibly by this time the question has arisen were we actually bringing about conditions that would lead to gangrene if the omentum were not so placed as to prevent the same. To satisfy our minds on this subject we did a simple control cutting off the blood supply to 16 cm. of the lower ileum using absolutely the same technique as in the preceding experiments except in this case no omentum was placed about the gut. The following day the dog was plainly sick the second day he showed signs of peritonitis and on the third day died. Autopsy showed a general peritonitis. The intestine where the blood supply had been cut off evidenced marked gangrene its lower part was ruptured in fact almost completely everted for about 7 cm. The omentum of its own accord had

made a noble effort to protect this area being adherent for about 3 cm. along the upper border here there was no perforation the gut was lighter in color and much healthier. The death of this our control dog from a peritonitis following gangrene and perforation of the gut after ligation of its blood supply proves in our minds at least that the omentum was the life saving factor in the other four dogs.

#### SUMMARY

It seems to us that we have proved the omentum quite capable of caring for gastric and intestinal perforations of varying sizes that it can be used to advantage in anastomotic work and is capable of preventing gangrene of large areas of gut wall. Having seen the results of the experimental work the last question that confronts us is naturally what are a few of the practical applications in abdominal surgery?

1 Since adhesions cannot be prevented and since they do occur in a large majority of instances make use of them.

2 Omental adhesions are less dangerous therefore are preferable to adhesions between adjacent loops of gut.

3 Utilize the free border of the omentum at the time of operation rather than allow it and adjacent viscera to form promiscuous adhesions.

With this in view we advance a few surgical conditions in which it may be used.

1 In perforations caused by various means gunshot wounds perforated ulcers as gastric duodenal typhoid etc. where the patient is in a shocked condition too weak or too asthenic for more extensive procedures in other words where time is an important factor this serous apron can be quickly sutured around the opening and the abdomen closed. In one of our clinics recently where perforation was caused by an abscess from a gangrenous appendix the patient not in a condition permitting resection the omentum was wrapped around and recovery followed the operator proclaiming at the time in his usual forcible manner. Should obstructive adhesions form two operations and a live patient are better than one operation and a mortuary.

- 2 To repair punctures in the mesentery
- 3 For the protection of raw surfaces to prevent adhesions
- 4 In excision of hepatic tumors the omentum may be utilized to advantage to give a broad base for the hemostatic suture of the excision wound
- 5 In drainage of the common bile duct wrap the omentum around the drain to prevent leakage Also where a part of the common duct has been removed a new duct may be constructed of omentum
- 6 For the relief of pyloric stenosis cut through the stenosed area and lay the omentum over the wound
- 7 Use the omentum to strengthen lines of abdominal vascular suture
- 8 In all resection of bowel and anastomosis wrap the free border of the omentum around Where resection must be done in

the least possible time the two ends of the gut may be approximated by a single through and through suture and the omentum quickly placed around the wound with the saving of minutes

9 We have shown that the omentum can be used to prevent gangrene therefore in strangulation of the gut from numerous conditions as for example strangulated hernia volvulus etc where there is doubt as to the viability of the gut the omentum may have one of its greatest fields of usefulness Likewise in mesenteric thrombosis where there is doubt as to the blood supply to a certain area

The results of our work have been so uniformly positive and convincing that we feel no hesitancy in advancing our findings with the hope that this work may be further enlarged and eventually prove of practical operative value to the surgeon

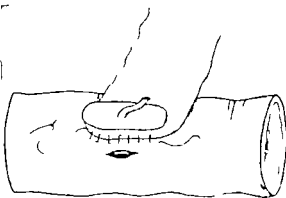
## RECENT EXPERIMENTAL STUDIES OF THE PANCREAS

By HARRY H. PATRIE, LOUIS A. PYLE AND CLAIRE F. VALE

**I**N the past few years considerable experimental work has been undertaken with the primary idea of developing a practical method of re-establishing communication between the pancreas and the intestines when the normal communication has been impeded or destroyed or in such cases in which for one reason or another such as malignant disease of the head of the pancreas or of the common duct etc it would be advisable to completely remove the head of the pancreas

Before taking up the discussion of our problem in itself it would perhaps be advisable to make a short resume of the work already accomplished along this line Coffey<sup>1</sup> in 1909 first took up this work His operation which he called a pancreato enterostomy consisted of uniting a U loop of the small intestine after the manner of the Finney pyloroplasty and anastomosing into this loop the end of the pancreas In the anastomosis he used the uncinate process the tail and also the head of the pancreas after removing the

uncinate process by a partial pancreatectomy His technique was of necessity quite complicated because of his idea that it was necessary to provide apposition of a considerable area of surface of the intestines with that of the pancreas to prevent the possibility of leakage into the peritoneal cavity The results of his work were satisfactory Later he attempted on a series of six dogs an anastomosis of the pancreatic duct with the small intestines His technique here was similar to that of a choledochenterostomy in which the duct is interposed between the coats of the intestines for an inch or so before being introduced into the lumen of the intestines with the hope of producing a mechanical valve action by introducing the duct between the muscular coats of the gut In this part of his work he was unable to get good results and predicted that such an operation was unsafe if at all practicable Within the past few years the same idea of a pancreato enterostomy was worked out in this laboratory but with a much more simple technique The procedure was simply to sew the cut end



I I at to ton

of the pancreas into a slit in the intestines with a line row of Lambert sutures comparable to the first and last rows of sutures in a gastro enterostomy. The operation was practically that of an end to side intestinal anastomosis except that instead of simply being approximated to the wall the end of the pancreas was tucked into the lumen of the gut. The result of this work was satisfactory and greatly simplified the elaborate technique of Coffey.

In any work on the pancreas the all important subject of acute pancreatitis which has always made the surgeon so timid in pancreatic surgery must be kept in mind. To review the work undertaken to determine the etiology of acute pancreatitis would be too long a task in the time allotted to us. Suffice it to say that at present acute pancreatitis is considered a disease in which the proteolytic fermentogen of the gland activated and set free acts with its terrible digestive powers on the living tissues of the body. This activation may be produced by sterile autolysis as from trauma of rough handling etc. or by infection which is thought to occur by way of the duct the blood and the lymphatics and which in causing a toxic death of the pancreatic cells would compare with autolysis.

The human pancreas in cross section is too large in relation to the lumen of the gut to lend itself practically to such anastomosis as described above. Therefore we undertook the problem of direct anastomosis of the ducts of the pancreas with the intestines in an

effort first to determine whether or not such a procedure would be successful second to determine which portions of the ducts could be used if at all and third to make certain observations in regard to the etiology of acute pancreatitis.

In these operations after occluding the existing ducts of the pancreas we performed anastomosis of the duct of the uncinate process with the duodenum of the main duct with the duodenum after removal of the uncinate process and the head or of the duct of the tail with various loops of the small intestines and the colon.

The technique of our procedure was as follows. The main and accessory ducts of the pancreas were doubly ligated and cut between the ligatures. Then to prevent reformation of the ducts which occurs even after double ligation a loop of omentum was carried between the cut ends and sutured in place. The uncinate process was freed and the end snipped off. By gauze dissection the ducts were stripped out for a distance of three fourths of an inch. The posterior edge of the stump of pancreas was then sutured to the intestines by a continuous seroserous stitch as is used in the first row of sutures of a gastro enterostomy. A small puncture was made into the lumen of the gut and the free end of the duct pushed into it. Then the seroserous suture was completed around the anterior edge of the pancreatic stump (Fig 1). In anastomosing the main duct the uncinate process was dissected from its attachments and it and the head of the pancreas were removed. The main duct was then stripped out and anastomosed as before into the duodenum. In using the tail we dissected it out for about three inches and stripping out the duct as before anastomosed it to any handy loop of jejunum and to the transverse and descending colon.

The results of our experiments were as follows.

In a series of four dogs in which the duct was stripped from the uncinate process and anastomosed to the duodenum after the manner described above all four dogs showed an uneventful and perfect clinical recovery. Autopsies after four ten eleven and twelve

weeks respectively showed that the new ducts in all were patulous and of normal size. There was no evidence of leakage or suppuration and only a few adhesions were present. The main and accessory ducts were closed in all four. The pancreas of one specimen was atrophied to a slight degree. The others were normal.

In a series of two dogs in which the uncinate process and the head were amputated and the duct of the proximal end was stripped up and implanted into the duodenum both dogs also made a perfect recovery and showed no clinical symptoms. They were autopsied six and one half and seven and one half weeks after the operation and the implanted ducts were found open. There were a great many adhesions to the wound but otherwise both were good specimens.

In our last series of ten dogs in which the duct was stripped from the tail and used for the anastomosis the results were as follows. One dog died of distemper pneumonia seven days after the operation but the specimen even in that time showed a good result. Six dogs were sick for a day or two immediately following the operation but except for that made good recoveries clinically. Four of these dogs autopsied at five five and one half seven and eight weeks after operation showed the old ducts closed and the implanted ducts open except for one in which no patulous ducts could be demonstrated. There was no fat necrosis leakage suppuration pancreatitis or pancreatic atrophy and scarcely any adhesions. In two dogs killed with gas seven weeks after operation the main ducts were found patulous due to the fact that we had neglected to suture a loop of omentum between the cut ends. In one of these the implanted duct also functionated and in the other it was closed. No pathological findings were seen in or about the pancreas. The remaining three dogs of this last series developed acute pancreatitis and died one three and five days respectively after operation. At the autopsy of the first, the peritoneal cavity contained a small quantity

of bloody fluid there were several patches of fat necrosis in the mesentery and omentum and the tail and body of the pancreas were dark red. A small gauze sponge was found deep down against the pancreas which in itself was enough to account for the pancreatitis. The second dog on autopsy showed very beautiful fat necrosis. In the tail of the pancreas an abscess cavity full of pus was found. The cause of this abscess was undoubtedly leakage from imperfect suturing. The third autopsy revealed bloody fluid in the peritoneal cavity and a mass of adhesions about the site of anastomosis in the center of which an abscess was found as in the last case. There was some fat necrosis around the pancreas. Faulty technique was again the cause of this abscess.

#### CONCLUSIONS

1. The question of a direct anastomosis between the pancreatic ducts and the intestine is of comparative technical simplicity and ought to be easily applicable to the human pancreas.

2. Any portion of the pancreatic duct can be used with equal ease. Our few failures when working with the duct of the tail we ascribe to the difficulty in getting at the tail the pancreas having been subjected to more trauma and less perfect suturing.

3. Ascending infection of the duct did not occur in our experiments it would seem therefore that the explanation of the ascending infection of glands with excretory ducts is not to be found in the assumption that the infection travels upward along the duct lumen or the duct mucosa. Even when we anastomosed the duct into the descending colon where infection is most likely to occur no pancreatitis developed.

4. The alleged sphincteric action of a band of circular muscle at the ampulla of Vater and the ampulla of the pancreatic duct, as a factor in preventing infection from the duodenum can be discredited. In our anastomoses we created no such valve and yet we failed to get infection.

## STUDIES ON THE TRANSPLANTATION OF THE URETERS INTO THE INTESTINES

By J. S. BAIRD, ROY L. SCOTT and R. D. SPENCER

**D**URING recent years the problem of transplanting one or both ureters into the intestine has repeatedly been the subject of theoretical discussion and practical experiment. Some varying results have been obtained as to the possibility and expediency of this operation.

The first one to attempt this was Simon who in 1851 performed it for exstrophy of the bladder and for the same condition Thomas Smith in 1879 implanted both ureters into the colon extraperitoneally. In 1891 Kuester of Marburg resected the whole bladder for carcinoma and implanted both ureters into the intestine. All three of these cases resulted fatally.

The first successful operation of this kind was performed by Chaput in 1892. The case was one of ureterovaginal fistula and the ureter was united with the rectum by a double row of sutures. This patient survived for 13 years and died of causes not pertaining to the operation. Many other cases may be cited since this work was started more than 25 years ago and a great deal of experimental work has been done on the lower animals both in this country and abroad but the results have lacked the uniformity that permits of a favorable prognosis in a high percentage of cases.

The indications for the performance of such an operation in man are rather rare. The principal ones are

- 1 Injury of the ureter which cannot be sutured or implanted into the bladder
- 2 Ureteral fistula
- 3 Cystitis dolorosa (Trendelenburg)
- 4 Total cystectomy necessitated by malignancy or chronic infection
- 5 Exstrophy of the bladder

In attacking the problem of transplantation of the ureters into the intestines it has been shown that general peritonitis, ascending infection of the kidneys and cicatricial contraction of the opening into the intestine through

which the ureter must pass are in the order named the three difficulties which oppose the success of the operation. Of these ascending infection of the kidney is of the greatest importance and this factor must be eliminated before there can be any hope of making this operation a success.

It is about this that we have concerned ourselves but the first thing we must know is the pathology of its pathway to the kidney. Three routes for the ascent of infection to the kidney appear to be present: ureteral lumen, blood vessels and the perireteral lymphatics if such there are.

The work done by Sweet and Stewart (1) in 1914 seems to prove conclusively that an extensive network of lymph vessels and channels exists in the mucosa, submucosa and external coats of the bladder and ureters and in the entire kidney structure. This network in the ureter anastomoses freely with the lymphatics of the bladder at one end and the lymph apparatus of the kidney at the other. These investigators have apparently further established the fact that infection ascends through this lymph system alone and not through the blood vessels or lumen of the ureter. The blood vessels are excluded because the veins of the bladder and ureter for the greater part empty into the general venous circulation and not into the kidney venous system. The ureteral lumen can be excluded because if the ureter be directly opened to infection the infectious process can never be traced along the mucosa but it is found in the lymph channels and if the continuity of these lymph channels be interrupted the infection does not ascend to the kidney at all. Furthermore if the lumen be closed against infection but the lymphatics be not disturbed the infection ascends in the usual manner. Finally it was demonstrated that if the kidney pelvis be directly connected with the intestine the general infection characteristic of ascending infection does not occur.

If infection ascends along the lymphatics and not up the ureteral lumen we might succeed if we could avoid infection i.e. not try to block infection by valve construction etc. but escape the infection itself by preventing its occurrence. In any attempt to place the ureter into the bowel a wound of the bowel wall must be made and this becomes a lodging place for the pyogenic organisms always present in the intestinal contents. A pyogenic focus forms and we have the ureter ending in an abscess. If this focus be the source of the infection could we avoid this ascending infection of the kidney by introducing the ureter not through a wound but through a normal opening in the bowel wall?

We thought we could by utilizing the opening of one of the pancreatic ducts since the dog unlike man has two such ducts either one of which is capable of conducting the entire pancreatic secretion to the duodenum.

The technique of this procedure is as follows. A midline abdominal incision is made and the right ureter identified isolated for the greater part of its course and severed just above the bladder. A silk suture is then passed through the free end of the ureter. The main pancreatic duct having been identified isolated ligated and cut between the ligature and intestine the silk suture threaded on a needle is brought up and passed into the intestinal lumen through the pancreatic duct opening and carried through the intestinal wall directly opposite. The other end of the suture through the ureter is then passed through in a similar manner emerging from the gut about a centimeter from the other. Traction is then made upon these sutures and the end of the ureter is guided into the intestinal lumen through the duct opening. It is held in place by tying tightly the suture. Nothing further is done except to close the abdominal incision.

We present five cases in which this technique was carried out. At autopsy some seven to ten weeks later there was absolutely no sign grossly or microscopically of an infection of the kidney. There were present the three possible tracts of infection to the kidney under practically the same conditions that formerly gave ascending infection.

Our work would seem to confirm the conclusions reached by others who worked by different methods that when the perireteral lymphatics are not directly in contact with a virulent infection there is no ascending infection of the kidney. By passing the ureter through a normal opening into the intestine we were able to eliminate this focus of virulent infection which gains a foothold in the intestinal wound when an abnormal opening is made. Also that valve action at the ureteral opening is of inconsequential value.

Now with one ureter transplanted into the intestine and ascending infection eliminated the question arose as to whether or not this kidney would continue to functionate normally and if so would it be possible to transplant both ureters thus pouring the entire urinary output into the intestine with no bad results. We are aware that in birds and certain lower mammals the cloaca which acts as a common receptacle for both urine and feces before ejection from the body is the normal condition. Would it be possible to give rise to a similar condition in higher mammals?

To find the answers to these questions we proceeded as follows. Experiments were performed upon dogs with transplanted right ureters. The abdomen was opened and the left ureter identified isolated and a catheter inserted into it. Next the right ureter was cut near its entrance into the duodenum and a catheter inserted into it. During the next 45 minutes the right kidney excreted 15 cubic centimeters and the left 20 cubic centimeters but the sodium chloride and total nitrogen content of the two specimens were equal. To test the renal function one cubic centimeter of phenolsulphonaphthalein was injected intravenously. The phthalein appeared 1 minute and 20 seconds earlier in the left kidney but titration showed that the two specimens contained the same amount of phthalein during the subsequent period of collection. This leads to the conclusion that the right kidney was functioning properly and equally as well as the left.

To solve the second problem we took dogs with transplanted right ureters and after four to six weeks did a left sided nephrectomy. In all cases the right kidney appeared nor

mal at this time. Within 48 hours came symptoms of nausea vomiting gradual loss of appetite rapid emaciation. The dog would lie on his side and gradually become dull and stuporous being hard to arouse and finally dying in a comatose condition in from seven to twelve days.

Autopsy on these dogs showed no gross pathological lesions to account for their death. Furthermore slight pressure along the pelvis of the kidney and the ureter was sufficient to express urine through the patulous opening of the ureter into the duodenum. These facts lead us to the conclusion that this one kidney was excreting normally and that the urine was gaining access to the duodenum.

It seems safe to conclude that the substances in the urine which when retained give the symptoms of nephritis can be absorbed from the intestine. Whatever this toxic substance in nephritis may be it seems of considerable interest to note that it can be

taken into the blood from the intestinal tract unchanged in its passage through the intestinal mucosa.

#### SUMMARY

1. Ascending infection travels up the ureter by the lymphatics and may be prevented by transplanting the ureter into an opening simulating a normal intestinal opening in such a way that it prevents the formation of a focus of infection at the immediate site.

2. That the kidney with its ureter so transplanted will continue to functionate normally.

3. That a valve action at the ureteral orifice is not essential.

4. That the entire urinary output cannot be drained into the upper intestinal tract as its absorption gives toxic symptoms ending in death usually within twelve days.

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## EXPERIMENTAL STUDIES IN COLONIC DILATATION

By JOHN ALEXANDER, JOHN HANCOCK ARNETT and JAMES A. H. MAGOUN

**E**VEN before the publication of Metchnikoff's book *The Nature of Man* in 1903 (1) there had been a growing tendency upon the part of some of the medical profession to regard the colon as to a great degree a vestigial structure and to use the words of Dr Barclay Smith of Cambridge (2) a useless encumbrance to man.

Apparently Mansell Moullin was the first to perform the operation of anastomosis of the ileum into the colon ileocolostomy for chronic constipation (3). Sir William Arbuthnot Lane of London in 1904 (4) published a monograph in which he described his success with the operation in glowing terms and since then until 1909 was a most enthusiastic supporter of ileocolostomy as a means of curing cases of chronic intestinal stasis which proved intractable to other methods of treatment.

The fact that Lane several times modified

his original operation and in 1909 began to advocate excision of the colon instead of ileocolostomy (5) shows that up to that time the later operation could not have been a complete success. And the statistics reported from his clinic for excision of the colon show that even in the hands of this most skillful surgeon the mortality for this operation is high and the results are anything but brilliant (6).

What has led many surgeons to give up the operation of ileocolostomy for the cure of chronic constipation is a peculiar dilatation of the short circuit part of the colon which so often follows the operation. The fecal material upon reaching the lower colon through the ileocolostomy opening backs up toward the cecum and distends this part of the colon until it becomes a huge sack full of feces. Exactly how often this untoward result occurs following ileocolostomy is impossible to say but from the literature upon the subject it would appear to be a compar-

tively frequent occurrence Moynihan says

In every case with one exception in my own series there has been some regurgitation of the intestinal contents upward along the descending colon into the cæcum (7)

In approaching the problem from the experimental standpoint we attempted to determine first does dilation occur following ileocolostomy in the normal dog second what is the cause of the dilation? We made out the following list of the most plausible causes which have been put forward to explain this dilation and proceeded to test whether they would produce the same condition in dogs

*Mechanical* Need for the stimulation given by the squirt through the normal ileo-cæcal valve (8)

Need for *vis a tergo* to push colonic contents onward Obstruction produced by adhesions links etc (9)

Rough materials stimulating bowels to peristalsis no longer pass into the cæcum but through anastomosis instead

*Chemical* Toxic products and bacteria allowed to remain in contact with the wall of the colon

Interference with blood supply to colon

Autointoxication from colonic contents regurgitating into ileum (10)

*Muscular* Area of increased tonus (11) at anastomosis leading to undue reverse peristalsis

Muscle continuity of intestine broken

*Nervous* Nerves presiding over colonic movement injured (a) Local neuromuscular mechanism (12) (b) Nerve fibers

Atony of the bowel resulting from any operation upon it

We were unable to produce dilatation at all comparable to that which occurs in man, by any procedure resembling ileocolostomy as it is performed in the operating room This answered the first question in our problem Ileocolostomy in the normal dog does not produce noteworthy dilatation It also demonstrated the following interesting facts

1 That no factors on the list single or in combination could be proved capable of producing marked dilatation in a normal dog following ileocolostomy



Diagrams of experimental operations

1 End-to-side ileocolostomy upon six dogs Ileum anastomosed at varying points into colon No dilatation

2 Ileum anastomosis close to valve in two dogs one of these gave a slight dilatation which did not occur when the same operation was repeated

3 Ileum proximal to valve severed Ends turned in Valve excised Lateral anastomosis leaving a wide opening at the point previously occupied by the valve One dog No dilatation

4 Lateral anastomosis without severance of the ileum Lumen of ileum obliterated at *a* after thorough denudation of mucous membrane One dog No dilatation Ileum found normally patulous at autopsy

5 Mucous membrane of ileocecal valve denuded and valve snipped leaving four flaps which were stitched back One dog No dilatation

6 Ileocecal region excised and anastomosis of ileum into colon below Two dogs No dilatation

7 Lateral anastomosis without severance of ileum One dog No dilatation

8 Same operation as No. 7 then a U shaped copper wire as shown was sewed to the colon below the anastomosis so as partially to occlude its lumen and act as a fore gut body irritant as well One dog No dilatation

9 Distal end of sigmoid end-to-side into ileum One dog Dilatation

2 That the colon of the dog is however capable of huge dilatation (Experiment 9)

3 That animals in whom the contents of the colon are free to regurgitate into the



ileum do not suffer from autointoxication as suggested by Kellogg (10). Such dogs weighed by us averaged an increase of body weight of 748 grams in 157 days.

4 That if there is any myoneural mechanism at the ileocecal region as suggested by Keith (12) this is not essential to the emptying of the colon itself (Experiment 6).

5 That even in the presence of a wide ileocolostomy opening unless the ileum is excised proximal to the valve the fecal current has a strong tendency to follow its normal course (Experiments 4 and 9).

The routine which we pursued in our work was as follows. The dogs were weighed before operation and before autopsy. To record the size of the colon above and below the ileocecal valve nine measurements were made at fixed distances above and below the valve the gut being measured in two perpendicular diameters. The time between operations and autopsy varied between 20 and 195 days. Results from dogs dying in less than 20 days were discarded.

In searching for the explanation of dilatation after ileocolostomy perhaps surgeons have been too prone to look to the operation itself or some fault in technique as the cause of the dilatation. We tried various operative techniques and deliberately produced the results of errors in technique and yet we failed to get any marked dilatation. We were forced therefore to give up the idea that dilatation of the colon following ileocolostomy is due chiefly to the operation itself or faulty technique in its execution and to accept the view suggested by Ochsner (9) and others that the underlying cause for the stasis for which the operation was performed was also the cause of the dilatation itself.

What the explanation for the original stasis may be whether due to a neurosis to infection to faults in the sympathetic nervous system or ductless gland system to diminution in the tone of all the muscles of the body (14) or a preceding trauma to the colon from too great distention (Experiment 9) or other causes must be the subject of further investigation. However until the causes of chronic intestinal stasis are better understood the operation of simple ileocolostomy should be abandoned for in a large number of cases the same cause which produced the indication for the operation will also cause its failure. Furthermore we have no means of determining as yet just how far a colon may be damaged by chronic intestinal stasis and recover. There is obviously no use in operating upon a colon to rest it by a short circuiting operation when the entire wall has already been damaged beyond recovery. This is one more reason for giving up simple ileocolostomy. The operation should be abandoned until the cause of the intestinal stasis and the pathology which it produces are thoroughly understood.

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# DEPARTMENT OF TECHNIQUE

## A TECHNIQUE FOR DRAINAGE OR EXCISION OF THE SEMINAL VESICLE

By JOHN H. CUNNINGHAM, Jr. M.D. F.A.C.S. Boston

IN the year 1901 Dr. Eugene Fuller presented a technique for drainage of the seminal vesicles enumerated a type of case in which he considered it applicable and recorded the result in a small series of patients upon whom he performed the operation. Since that time he has written much upon the subject pointing out the symptomatology indicating the procedure and has given the results in a series of over 300 cases.

For whatever reason, the genito urinary surgeon has been slow to appreciate what Dr. Fuller has repeatedly shown but at present the truth of his teaching is fully appreciated by those who have learned to recognize the types of cases suitable for seminal vesiculotomy. Due credit will unquestionably be given to Fuller as the value of the practice of surgical drainage of infected seminal vesicles is more generally realized and the profession will remain indebted to him for it as it has for instituting the practice of massage of the vesicles and prostate in certain diseased conditions of these structures.

In selecting cases for seminal vesiculotomy we include those who have had any of the local or general manifestations dependent upon focal infections in these organs which cannot be overcome by the usual non operating methods of treatment.

The pathological classification consists solely of acute to chronic non tubercular grades of inflammation of the genital tract beginning with the prostatic urethra and including the structures therein—the prostate vesicle vas or epididymis—with the predominating features of the inflammation located in the seminal vesicles. It is the retention of the products of inflammation in the seminal vesicles and in some degree in the prostate that results in the clinical symptoms both local and general.

A clinical classification which serves to select the cases suitable for operation is based on the most important symptom or group of symptoms but it must be obvious that such a classification must be most arbitrary as different groups of

symptoms often exist together in some measure in many cases. The following classification is based on the most prominent subjective symptoms and the objective findings.

1 *Inflammatory group* a Acute suppuration occurring most often in the vesicles and prostate in the course of acute urethritis resulting in a febrile state and presenting locally a swollen tender prostate and distended painful vesicles. The condition is generally treated by confinement in bed local applications and drugs to relieve pain with the result that after the acute process subsides there persists a urethral discharge from subacute or chronic seminal vesiculitis and prostatitis which lasts for weeks or months even with appropriate local treatment.

b The chronic inflammation which has but a slight or no severe acute stage characterized by an obstinate urethral discharge proved not to originate from the anterior urethra and the material expressed from the vesicles and prostate showing by massage or coitus fresh or old blood or the products of inflammation in the gross and microscopical examinations. Cases of recurrent epididymitis associated with the condition just mentioned and ejaculation of bloody semen point to disease in the vesicles. While most of the cases of this group may be cured by appropriate non operative treatment there are others which cannot be sufficiently drained through the natural channels and which must be subjected to operative drainage of the vesicles and prostate to effect a cure. There are cases of cystitis which can be explained in no other way than by the extension of the inflammation in the vesicles to the bladder wall and mucosa.

2 *Pain group* Under this heading is included those with persistent perineal pain sometimes accentuated by defecation and often referred to the rectum indefinite in character but extremely disturbing to the individual and often associated with neurotic symptoms painful erections without sexual stimulus frequent nocturnal emissions sometimes painful and bloody semen.



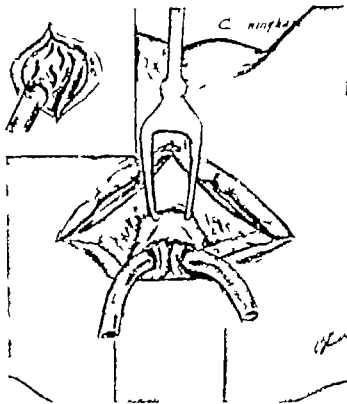
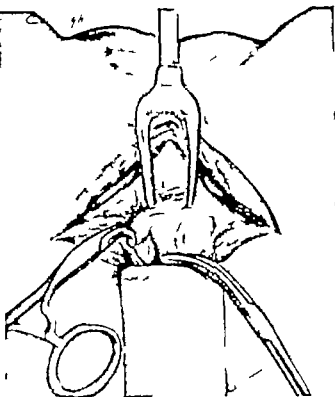


Fig. 3 Shows special double tenaculum inserted into the prostate just in front of the junction of the prostate with the bladder elevating the prostate and exposing the vesicle area. One incision is seen showing through the fascia of Desnonvillier and on the other side the fascia divided and retracted exposing the vesicle. At the bottom of wound special retractor over rectum.

Fig. 4 Shows the drainage tubes caught in the structure of the vesicles by a catgut suture and the incisions into the prostate tissue. Both vasa deferentia are seen between the tubes. Inset shows in detail the opened ducts of the vesicle with sutured tube in position, the opened vas deferens and the retracted fascia of Desnonvillier.

identifying the apex and the posterior surface of the prostate and freeing the rectum from it as much as possible (Fig. 1). The index and second finger of the left hand are then placed in the fossa pressing the rectum downward and the median tendon and recto urethral muscle which attached the rectum to the urethra is divided as near the bulb of the urethra as possible (Fig. 2). With division of the recto urethral attachment the muscular fibers of the levator ani muscles may be seen attached to the posterior surface of the prostate and these fibers are freed by blunt dissection from the posterior and partially from the lateral surfaces of the prostate. This blunt dissection freeing the rectum is carried beyond the junction of the prostate with the bladder exposing the vesicle area and the base of the bladder.

The rectum is protected by a piece of gauze placed to the bottom of the wound and a flat retractor either  $1\frac{1}{2}$  or 2 inches in width according to the width of the bony pelvis and with an abrupt curve and long enough to reach the bottom of the wound is inserted. This special retractor is furnished with a weight so that it is self retaining.

The posterior surface of the prostate and bladder are now visible. A special double tenaculum is inserted into the prostate tissue just below its junction with the bladder. By lifting the prostate with this instrument the base of the bladder and the vesicles may be visible beneath the fascia of Desnonvillier provided this fascia is not much thickened by inflammatory exudate. The sulcus in the median line between the vesicles may often be palpated which however is not necessary if the dissection is carried well above the superior border of the prostate. The fascia in the vesicle area on first one side and then the other is picked up and divided and should be so freed as to bring the vas deferens into view and to allow the vesicles to be picked up with forceps and drawn out through the fascial incision (Fig. 3). The fascia varies greatly in thickness being normally as thick as writing paper may be nearly one quarter of an inch thick when involved in extensive perivesiculitis. While there is usually a line of cleavage between the fascia and the vesicles the fascia and vesicles may occasionally be so bound together that they cannot be freed from one



## THE TREATMENT OF COMPOUND FRACTURES OF THE HUMERUS AND FEMUR BY NEW APPARATUS

By H. T. BUCKNIR, M.D., SEATTLE, WASHINGTON

SINCE the beginning of the present great European war many new apparatus have been devised for the treatment of compound fractures, some of which have proved very successful and all of which have their good qualities in certain cases.

In this paper I wish to present two new apparatus that have proved very successful in many respects. The apparatus for the treatment of fractures of the humerus was devised by Doctor Lisandro Leiva of Bogota, Colombia, and the one for fractures of the femur was devised by myself. Both were constructed and are being used at the American Ambulance Hospital of Paris.

In the treatment of bones fractured by modern war implements many things must be taken into consideration, especially the size of the wound, the amount of comminution of the fracture, the amount of substance lost, the amount and kind of infection and what kind of result can be obtained.

Both of the apparatus have many points in common points that are very essential in the treatment of fractures:

1. They are open or can be adjusted so that a wound in almost any position can be easily reached and thus any method desired may be used for the sterilization of the wound.
2. They are adjustable so that the arm or leg can be put in any plane in order to obtain the proper alignment.
3. They have many adjustable parts so that all the joints can be moved thus preventing ankylosis.
4. Extension can be applied and maintained continuously.
5. They are adjustable so that they can be used on either the right or left side.
6. The bone can be firmly fixed yet there is free access to examine the skin so that any undue pressure in any one part may be detected and overcome.
7. With the arm apparatus the patient can be up and around without any interruption to his progress. He does not have any difficulty in lying down. He can lie either on his sound side or on his back. He can be taken to the fluoroscopic room and examined with the apparatus applied to see that the proper reduction has been made.

With the femur splint as with all others the patient must remain in bed yet X-ray pictures can be taken with the splint applied.

I shall consider each apparatus separately giving a description of each with some case histories and X-ray pictures of the results obtained.

### ARM APPARATUS

The arm apparatus really consists of two parts: A body piece and a metal frame to support the arm.

Figure 1 is a photograph of the apparatus with out the body plate. To the bars *1 B* and *C D* is attached a piece of aluminum 25x50 centimeters which is curved so as to fit around the body. The lower edge is turned outward so the sharp edge will not produce pressure on the crest of the ileum. The aluminum plate is well padded with cotton and covered with canvas. Three

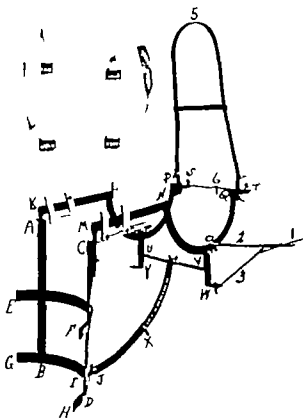


Fig. 1. Arm apparatus without the body plate. Full description is given in text.



Fig. 5. The arm apparatus applied. The forearm and joint is in a pronated position and the elbow is in a pronated position.

buckles are applied to each end. The two middle ones being turned some what up and out.

Two canvas straps pass around the body and another over the shoulder on the sound side. The canvas straps attach to the metal buckle. These straps must also be padded especially the one that passes over the shoulder. The arm then rests in a little hammock that is attached to some pulley that runs on the bars L and M.

The forearm can be put in supination or pronation and in any position and position in the erect position as presented in the picture (Fig. 2). When the forearm is placed horizontally the forearm is marked 1 and 2 (Fig. 2) is used. This can be placed on either side of the arm. The humerus is fixed. When the arm is placed vertically then the arch part is used. This can be placed anywhere along the frame depending upon the length of the humerus.

It is a disadvantage to place this splint and place it in the hammock for the arm to rest in. It makes the base a little more firm. Another splint should be placed for the forearm and attached to bar.

One of the very essential things in the treatment of fractures is extension. This can be applied easily with either apparatus. It can be made by applying adhesive strips or gluing short cotton flannel strips to the humerus. To the end of these strips is attached a small piece of wood. To this piece of wood is attached a

piece of square rubber that is pulled tight as is necessary and fastened at the point O in the bar 57. If you wish to know just how much pull there is on the humerus you can attach a known amount of weight to the end of the rubber and while the weights are pulling attach the rubber at the metal joint after which the weight can be removed. Usually it takes from three to four kil. for a humerus.

Sometimes the wounds are large that there is not sufficient space to attach the extension tray directly to the humerus. Then a heavy weight bandage is put around the elbow and the rubber attached to the end of it.

In dressing the wounds they can be easily reached if they are on the outer or interior aspect of the arm. If the wound is on the under surface of the arm, the rubber can be removed and placed around the plinth and removed when the under surface will be exposed.

One of the features of both the apparatus is that in any position it is with out starting with the pressure of the union of the fracture. By simply opening the bolt at the point A the frame can be lowered or raised thus moving the arm with it. Opening the bolt at J the arm can be moved forward and backward making another very essential movement. When the forearm is placed horizontally opening the bolt at O and H the forearm can be considerably flexed and extended. When the forearm is



Fig. 3. Case 2 wounded March 4, 1916. Roentgenogram taken April 22 with the Delbet apparatus applied.

placed vertically the bolts at 5 and 7 can be opened to produce the same movement. By simply grasping the wrist and raising the forearm just a little the forearm can be supinated or pronated enough to keep the joint fluid stimulated.

If the extension is well placed and is fairly firm all these mentioned movements can be made without moving either fragment and with very little if any pain to the patient.

#### TREATMENT OF THE WOUNDS

The wound are treated with intermittent irrigations through small perforated rubber tubes as described by Dr. Alexis Carrel of the Rockefeller Institute. The rubber tubes are of very small caliber with one end closed.

The depth of the wound is estimated and many holes are punched in the tubes extending from the ligature or tied end to the skin surface. Many holes are punched so that when the fluid is run in the tube will act as a spray and all parts of the wound will be reached by the fluid. The holes must be small and they are best made by heating a needle and passing it through the tube

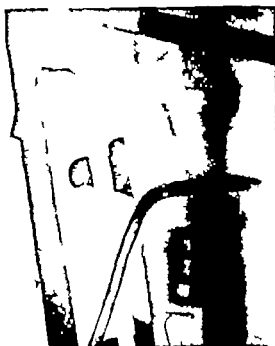


Fig. 4. Roentgenogram taken of Case 2 after reduction of fracture and application of Leyva apparatus.

As many tubes are used as there are places or pockets for the pus to collect.

The tubes that run across the surface area of the wound seem to distribute the fluid a little better if a piece of Turkish toweling is wrapped around the tube. The Turkish toweling only extends from the ligated end to above the perforations. The uncovered tubes seem to work



Fig. 5. Roentgenogram of Case 2 June 1 showing firm union. Apparatus removed.





1. Calcium chloride  
2. Sodium carbonate

of R. K. M.

1. 1 liter in the sun

The tube is held



Fig. 7. Roentgenogram of Case 3 taken April 9, before the Ley apparatus applied.

in place by a little plain gauze and this is placed in very loose so as not to interfere with the return flow of the liquid or the drainage.

We use a large cotton pad for the dressing and we make a hole in the center of it and pull the end of the tubes through. These tubes are then connected up with glass connecting tubes which have from two to four outlets.

The solution used for the irrigations is the one used by Dr. Doctor Dakin of the Rockefeller Institute and it consists of

Ca. 100 to the  
L. 100  
or 100 Water

Chl. d. of lime  
Sodium carbonate dry  
S. 1 ml carbonate

20

8

The chloride of lime is put in a flask with a half liter of sterile water and shaken thoroughly and then allowed to stand over night. The sodium carbonate (dry) and bicarbonate are then put in another half liter of sterile water and dissolved. The two mixtures are put together and shaken thoroughly again and allowed to stand for a time and then the clear solution siphoned off and filtered. Cold water should always be used and the solution should be used at room temperature. If heat will decompose it liberating chlorine.



Fig. 8. Roentgenogram of Case 3 taken after the Ley apparatus had been applied.

thus rendering the solution inactive. The solution is used in a 1:200 dilution.

The irrigations are best made from an irrigation bottle that is placed at a fixed height so the same pressure will be exerted each time. The bottle is placed one meter above the wound. A rubber tube runs from the bottle to the glass connecting tips. This tube should be of sufficient caliber so that when the solution is turned on it will fill the glass tips entirely, thus permitting the solution to run out in equal quantities from the small outlets.

Sometimes a glass dropping chamber is inserted in this tubing from the bottle for a continuous drip, but this does not seem to work so well as the small glass connecting tip will not be filled entirely and the solution will go out only one or two of the outlets, thus sterilizing only part of the wound.

It is always best to keep the tubes connected with the bottle and the tubes filled with the solution so that if any bacteria lodge in the tubes they will be killed and live bacteria will not be rejected into the wound. The irrigations are made every two hours night and day. If the tubes are connected with the irrigating bottle the irrigations can be made at night without any interruption to the patient's sleep. The solution is often quite irritating to some skin and inflammation is largely prevented by putting vaselined gauze around the wound. This is prepared by pouring melted vaseline over sterile gauze and allowing it to harden. A large piece of gauze is often better than several small pieces, as the one large piece can be opened up and spread out over the wound and skin and the part that is just over the wound cut away. By smoothing out the gauze the skin can usually be fairly well protected. As a rule the vaseline gauze does not have to be changed every day, but if the suppuration is marked and it is soiled then it is better to change it.

The changing of the dressings depends upon the amount of suppuration, as a rule once in twenty-four hours is sufficient, but if the suppuration is marked and a large amount of solution must be used then it will be necessary to change the dressing a little more frequently.

The quantity of the solution necessary depends upon the size of the wound and in most cases just a few hundred cubic centimeters is sufficient. The wounds are not irrigated to the extent of being flushed but are simply filled with the solution. When a tube comes out it is always a good rule to put in another that is absolutely sterile rather than try to cleanse the one that came out.

Smears are made from the wound every day or so and the number of bacteria noted per field. If the bacteria do not seem to decrease then the strength of the solution should be increased or it should be used a little more frequently. When several slides on successive days are found sterile or free from bacteria, then the wound may be closed. This is done either by a few silkworm sutures or better still by putting some hooks on adhesive plaster sterilizing placing on each side of the wound, and then lacing the wound closed by means of rubber bands.

This method does not close the wound so tight but that if a secondary abscess develops the pus will find its way out much easier. The technique described has proved very efficient in cases of most violent infection.

**CASE 1.** L. M. aged 32 wounded by a piece of shell on April 2, 1916 in the battle of Verdun. The patient was transferred in plaster and arrived at the American Ambulance Hospital on April 8. He was found to have a very large suppurating wound six centimeters long extending through the arm. On April 8 a roentgenogram was taken without the apparatus applied. The wound was dressed as described above and the apparatus applied. On May 22 the wound was entirely closed and firm union of the fracture had taken place.

This patient not only had firm union of his fracture but did not have anykylosis of any joint.

**CASE 2.** H. P. aged 38 wounded by a fragment of shell March 4, 1916 in the battle of La. Cheppe. This patient was transported with the Delbet apparatus and arrived at the American Ambulance Hospital March 31, 1916.

He was found to have a large wound of the right arm extending two thirds the length of the arm with marked suppuration and no union. He had some anykylosis of the elbow joint. The same apparatus was left on till April 22 when the suppuration continued and union had not taken place. Figure 3 was taken at this time. On account of the findings in this picture the Delbet apparatus was removed and the Leyva apparatus applied. The wound was then dressed as above. The patient was taken to the fluoroscopic room and the fracture reduced. Figure 4 was taken.

On May 30 the wound was entirely healed. On June 1 firm union had taken place and the apparatus was removed with the result shown in Fig. 5.

Firm union was also obtained in this case and the partial anykylosis in his elbows was broken up at the time the apparatus was removed.

**CASE 3.** L. M. aged 30 wounded in the right thigh by a fragment of shell on April 6, 1916 in the battle of Verdun. When he fell he fractured his left humerus but the fracture was only a simple one. He was transported in plaster and arrived at the American Ambulance Hospital of Paris on April 10 at which time Figure 6 was taken without the apparatus.

The Leclair apparatus was applied and on April 19, 1916 Figure 7 was taken.

In view of the above result the Leyva apparatus was applied and on June 1 the patient had firm union, as shown in Figure 8.

All the above cases were studied with the X-ray and fluoroscope. Of the following case I had

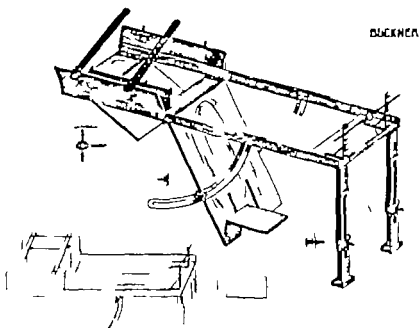


Fig. 9. Femur apparatus. Full description is given in the text.

no pictures taken until union had taken place and the apparatus had been removed.

**CASE 4.** This patient was wounded in the battle of Verdun on March 30 and arrived at the American Ambulance on April 7. He had been wounded by a fragment of shell and transported in plaster. He had a very large wound of his right arm with marked infection. The above method was used in the sterilization of the wound. The wound healed in three weeks. The apparatus was left on six weeks after which sufficient union had taken place so that the apparatus could be removed.

All these cases and many others recovered without any secondary complications as well as being fairly comfortable with the apparatus.

#### FEMUR APPARATUS

I shall make only a preliminary report of the femur apparatus. It is made almost entirely of wood and simulates a fracture box in many respects but is much more practical as it can be adjusted to almost any plane (Fig. 9).

The apparatus is well explained in the above photograph. The splint is put on the bed and the leg placed in it. It can be applied to either the left or right side. The splint can be placed straight on the bed extending over the foot, in which case the ordinary hospital bed or some bed with a low foot board must be used, or the splint may be placed off to the side of the bed. It can be placed at any angle depending upon the amount of abduction that is necessary.

Figures 10 and 11 represent the apparatus placed off one side of the bed. (In this instance the patient had a high fracture and the proper reduction was obtained at this angle.) The leg is put in the splint and the femur is held in place by coaptation splints. The sides of the splints are on hinges and can be opened or closed. They are held closed by two cross bars of wood. The leg is placed in the splint to the inner side. There is an adjustable coaptation splint which is the length of the femur and this can be screwed up against the femur thus splinting it firmly. The sides of the splint must be closed before the coaptation splint can be tightened.

The leg can be extended as shown in Figure 11 or it can be flexed as in Figure 10 at any angle. The leg is placed on a little chariot which is simply a piece of aluminum with a wire frame on the end of it for the foot to rest against. The end of the frame is cut circular so as to prevent any pressure on the heel. Two small pulley wheels are put on each side and they run on a heavy wire track. This little chariot arrangement is simply to release the friction and render the pull more upon the femur.

Two sets of extension straps are used, one long and one short. The long ones are fastened to the femur and is high up as possible. They are attached to some buckles that are fastened to a small block of wood to which the extension

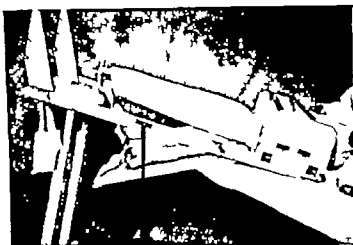


Fig 10 Application of the femur apparatus showing the possibility of flexing the leg at any angle

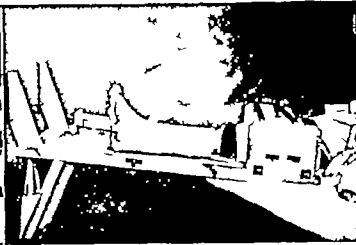


Fig 11 Application of the femur apparatus with leg extended and all straps tightened

cord is fastened. The short ones are attached to the leg below the knee and they attach also to two other buckles fastened to the same block.

The reason for the two sets of extension straps is that when you wish to flex the knee the straps can be loosened and the knee flexed without interfering with the extension upon the femur. Figure 10 represents the straps loosened and the knee flexed. Figure 11 shows all the straps fixed and the leg is placed straight.

If the extension straps are placed fairly firm and the coaptation splint is tight every joint can be moved without moving either fragment or producing much pain.

The patient can sit up straight in bed, moving the hip joint. The hip joint can also be moved by opening the bolts on the legs and raising the frame. When the frame is raised, the weights are also raised, thus keeping up the pull.

The knee can be flexed by simply loosening the straps and dropping the bottom.

The ankle joint can be manipulated with the hand.

It is customary to move each joint a little each

morning and leave it in a different position for a short time as this seems to prevent the formation of ankylosis.

The dressing of the cases is perfectly simple with this apparatus as the sides open out and the femur is easily reached. The under surface of the femur can be reached by opening the bolts on the legs, raising the frame fairly high and then opening the part or door under the femur.

The apparatus has many distinct advantages.

1. If the legs are attached to the floor the apparatus is firm and the femur can be firmly fixed in it.

2. The leg can be placed at any angle of abduction, adduction or elevation.

3. Each joint can be moved; extension and dressings can be easily applied.

It might seem that the inner side of the splint would hurt the patient, but this difficulty is overcome by applying a cotton pad over the end of the board.

In a later paper I shall present a series of cases with the X-ray results obtained with this apparatus.

IMMEDIATE COMPLETE AMPUTATION OF THE UMBILICAL CORD<sup>1</sup>

BY ROBERT L. DICKINSON, M.D. F.A.C.S. BROOKLYN

**A** GAIN after nearly twenty years I bring forward the petition that the only piece of surgery which has to be done on every human being should have its standard set not by midwife timidity but by the simple principles of surgical practice.

A bettered detail is presented but no new argument. The issue is simple. It is surgery versus a rough primary union versus slow granulation. With the line of demarcation clearly foreknown surgeons cut away what is sure to drop away then ligate then close in the raw surfaces.

The detail referred to is a handier form of suture ligature with an outward drag on the skin of the skin cuff of the cord to draw a fold sidewise away from the vessels for the needle to pierce first on one side then on the other. Thus the fearfulness of prodding a vessel that seems to withhold some men from suturing is banished.

## OUTFIT

*Needle* straight or curved with cutting point the point tested for wire sharpness.

*Silk* fine silk or linen or silkworm threaded into needle before boiling.

*Thumb forceps* or mouse tooth thumb forceps.

*Needle holder* if curved needle is used better for all needles as it saves touching the needle. Needle placed in holder before boiling.

Boiling the above in towel or in tray or dish. Not removed from towel or tray until used.

Sterile gauze sponges one or two and towels binder.

## STEPS

1. At the very moment of the exit of the navel of the child from the vulva a clean towel covers the cord and encircles the trunk.

2. The cord is clamped long and cut long.

3. Later when the mother is cared for child and outfit are laid on the table (Fig. 1). One hand of the nurse holds the baby's legs downward and towels are placed to cover the child. By means of the clamp placed at birth the cord is lifted straight up with the nurse's other hand. Thus the skin cuff is drawn out to its full length. Thumb forceps seize half of the skin cuff at right angles at its middle sliding the skin sidewise away from the vessels whereupon the needle pierces and takes up all of this upright fold near its base, near the belly and the thread follows. The opposite side is treated in the same fashion entering near the first entry coming out near the

first exit. We thus have a combination of buried ligature and inrolling skin suture.

4. The loop is held to one side and the cord still held upward tensely is cut away at or just beneath the skin edge. All white surface must come away and all or nearly all the jelly should come away.

5. The stitch is tied the skin inrolling altogether or nearly so.

6. A dry dressing is applied whereby the edges roll themselves in completely.

7. One or two days later the stitch is cut and removed.

This inrolling suture ligature I have used for fourteen years or more. It is simple to apply but less easy to describe. The diagrams (Fig. 2) will make the technique clear. Half of the cord is circled subcutaneously in the fat layer. Then the needle is carried outside to re-enter near the first entry in order to encircle the other half of the cord making exit close to the point of exit of its first trip. When this ligating stitch is tied the loop and the tied ends crossing the open surface draw together its two sides. Even if actual apposition of the skin edges does not result the invariable habit of the navel to retract within an hour or two secures apposition of the edges and these edges are sealed by a small blood clot or by dry serum. Primary union occurs except where the amputation has been too high leaving a certain amount of the shining covering of the cord or of jelly. Therefore one should see to it that he fearlessly cuts through and even carries away a little of the thin skin edge in order to provide raw edges to unite. A very sharp cutting needle is needed and sharp scissors as no skin is tougher than that hereabouts.

The after care consists in dry dressing with plain gauze or in any other fashion favored by surgeons for wounds where primary union is desired and where the stitch is to be removed within a couple of days. The best suture material is fine silk or linen either plain or impregnated. Silkworm is a bit clumsy. Catgut usually works well but does not live up to the best surgical technique and may produce redness by the second day unless No. 0 is used.

Oozing has not occurred nor has eczema. Theoretically the vessels might be supposed to retract inward away from the grip of this ligature.

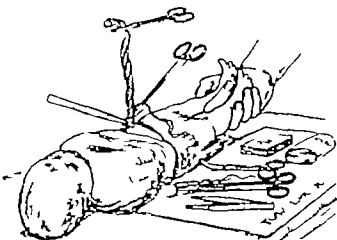


Fig. 1. Child and outfit on table. Baby's legs held downward by nurse.

Practically they are so adherent to the somewhat rigid sides of the opening that they do not slip.

Clips of various forms have been tried. Because of the general fear of the needle, I devised, many years ago, various substitutes in the way of clamps with needle points to bite into skin, some held by a lock, others by a spring. All have been abandoned. Michel clips, particularly in the large size, are effective but do not give assurance of vessel seizure. In using them the skin cuff is secured, held aloft between thumb and finger or by a transverse clamp with fairly springy blades until the clips are in place. Those familiar with clips may be more at home with this method. The original publication showed other experiments such as separate ligation of the vessels but these were soon abandoned.

The closure of the normal hernial opening — the umbilical — and the prevention of later bowel protrusion would not seem to be favored in any measurable degree by this procedure. The reason is that this suture does not bring into apposition denuded fascial surfaces. The most we do is to close the gap and this gap is made up of the lumen of the umbilical vein. If suture ligature at the level of the recti muscles or their sheaths causes agglutination of the vein wall and provides for the absence of a clot at this level then we have favored or hastened closure of the hernial gap. I have not made more than nine tests of placing deep dipped fascial bites.

Infection is of course invited by any lack of good technique and it is not to be supposed that a midwife will be trusted with this method. But any student who can sew up a scalp wound can put two stitches in a navel. Where the vulva is unclean or the navel of the child has come against faeces expelled with the birth or in a breech delivery — in other words where contamination

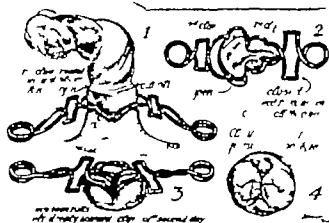
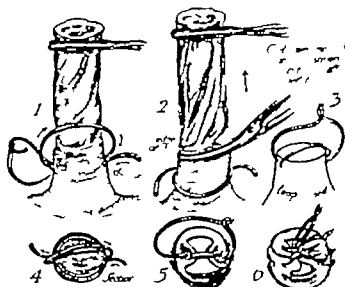


Fig. 2. Amputation of umbilical cord at the skin edge at birth by use of suture ligature or clip.

of the navel has occurred — one is not called upon to invite trouble by stitching. The one infection I have heard of was the result of the work of an interne under one of these conditions. Dr. Fry tells me he had oozing once. As far as I know other men have not had unfavorable results to report not having tried it. I have only one group of converts. All the nurses who see the after care, namely a cord sealed closed, clean requiring no dressing are keen about a process that risks no breaks of their surgical cleanliness from daily dressing of a sloughing wound.

The proposition to suture ligature was made in 1899.<sup>1</sup> Nothing ever fell flatter. At most it has been dismissed with a footnote of ridicule. But its adoption seems to me inevitable as soon as men midwives are trained to do cleanly minor surgery.

<sup>1</sup> D. Jones, R. L. I. sloughing process at the child's navel consistent with sepsis in child-bed? *Am. J. Obst. N. Y.* 1900 June (with review of literature to date).

<sup>2</sup> Cullen, T. S. *Embryology, Anatomy and Diseases of the Umbilicus together with Diseases of the Trachea*. 9th ed. pp. 45-46 and 97. '00.

## PERMANENT NERVE-BLOCK FOR CHRONIC INTRACTABLE PAIN

By FREDERICK G. DYAS, M.D., F.A.C.S., CHICAGO

**G**REAT as are the advantages of local anesthesia I believe that its greatest field of usefulness has just been opened up. I refer to the permanent nerve block for the relief of chronic pain.

This method of treatment must be reserved for those patients who have gone beyond the hope of other relief as in recurrence of malignant tumors after operation. If it were possible by the injection of those nerve trunks which supply the painful area to produce a localized analgesia the necessity for the use of morphine would be obviated and the unfortunate patient might be conducted to a peaceful end.

It is well known that morphine and other drugs of its kind do not entirely control the severest pain. I recently lost a case of recurrent carcinoma of the breast with enormous swelling of the arm upon the affected side in which the pain toward the last could not be controlled entirely by hypodermic injections of one and one half grains of morphine every two hours. It is in such a case that the proposed method of alcohol injection of the brachial plexus by the method of Kuhlensampf would render the entire upper extremity anesthetic. Of course at the same time there would be a motor paralysis because the nerve trunks are made up of both motor and sensory fibers. However the loss of motor power under such conditions would be negligible.

The same method can be used in carcinoma of the pelvic organs by blocking the sacral plexus.

For hopeless conditions of the upper abdomen the paravertebral injection of the intercostal nerves might be employed. This method was suggested to me by the well known use of solutions of alcohol in from 40 to 60 per cent strength, for injection of the trigeminal nerve in cases of tic douloureux.

Those who have used this method most extensively say that perfect analgesia is produced whenever the alcoholic solution reaches the nerve trunk. This analgesia persists from six to eight months. If this same analgesia can be produced in those nerve paths which conduct the painful sensation from the diseased area we shall be able to produce as complete a loss of pain for as long a time as in the case of trigeminal neuralgia.

I therefore predict for this method of local anesthesia its greatest field of usefulness and believe that the method of local anesthesia will continue to find more adherents for its use both for the production of temporary and lasting local analgesia.

I have used the method successfully in one case of uterine carcinoma by injection of the sacral nerves through their foramina and in one case of sarcoma of the shoulder by Kuhlensampf's method.

## CONCLUSION

Nerve block as a lasting anesthesia for chronic pain should find as wide an application as its use for operative procedure.

A SPIRAL WIRE DRAINAGE TUBE FOR SURGICAL DRAINAGE<sup>1</sup>

By FRANK A. GLASGOW, A.B. M.D. F.A.C.S. St. Louis, Missouri

THE experiences of the surgeons in Europe with the fearfully lacerated and infected wounds made by modern projectiles and explosives have taught them the futility of measures which until a year or so ago were considered nearly perfect.

In the war zone infected wounds are the rule. The gas bacillus is added to the organisms against which we have been accustomed to fight. Antiseptics of an efficient strength have favored sloughing and hindered repair. Bichloride, carbolic acid, and the cresols are falling into disfavor. Milder and less poisonous antiseptics have been sought.

The old Labarraque's solution, or this solution with its alkalinity (which was destructive) neutralized with boric acid is much in favor. The normal saline solution used as a constant bath or drip seems to have given the most satisfaction. Complete drainage is demanded. For some reason rubber tubes have not proved satisfactory. Perhaps it is because the drainage is not perfect as it depends on holes in the tube. Some tubes seem to have a destructive effect on the tissues perhaps due to sulphur or some other content.

I have thought that a far better drainage could be obtained by a tube made of fine wire wound as a spiral spring. For many years I have used with very great satisfaction such a drain with a button on the end as a stem pessary and drain for the uterus. I have accomplished with this results which could be obtained with no other method of drainage.

I first used a number of loops of silkworm gut fastened at one end to a lump of gutta serena. I then devised the following:

All that is needed is a knitting needle and some fine aluminum silver copper or best of all enameled copper wire.

One end of the wire is twisted around the end of the knitting needle for a few turns. The wire is then laid along the needle for two and one half inches and wrapped closely back over the wire toward the fastened end. When this end is reached it is cut off short close to the spiral. We now have a very flexible spiral with one end coming through the tube. This end is cut off to a length of three quarters of an inch and passed through a fair sized pearl button and then back into the lumen of the tube. This is the complete stem pessary and drain. It may pass around an

abrupt angle like a flexed uterus and still its lumen remains open. It cannot cause trouble by pressing on the wall of the uterus by its end as a stiff stem pessary does.

This spiral can be made very small for use in undilated non-parturient uterus or it can be made as large as a pencil for post partum cases. It has given me invaluable aid in the treatment of cases demanding drainage. I have used it in some cases of abscesses very successfully.

The uterine drain stays in well unless the cervical canal points in the axis of the vagina. In this case a Hodge pessary must be used to hold the cervix backward.

It has occurred to me that this drain might give better results in wounds than the rubber tube has done on account of the more perfect drainage into the tube and the smaller diameter for a given caliber. If made of fine silver or copper wire it seems to be as flexible as rubber tubing. The bare metal wire can be disinfected readily by pouring alcohol or whisky on it and setting it afire, or even holding it in a flame. The enameled wire can be boiled.

It can be fastened in a wound by a small wire passing through its caliber to the middle or end then between the winds into the tissue then back along the outside of the tube. Twist the ends and it together with the tube will remain until the stay wire is cut and withdrawn.

If this spiral drain is large enough a very small soft catheter may be pressed the whole length washing from the very bottom of the wound. Continuous drop irrigation if thought necessary may be used in this way.

The pliability of tubes made of Nos. 26 to 28 B & S enameled copper or silver wire will surprise any one who has not examined them. For the same caliber these wire drains are much smaller than rubber as the wire wall is very thin. Perhaps the metal of which they are made may have some specific effect on certain organisms. We know that the minutest trace of copper has a destructive effect on the typhoid bacillus also on algae. Perhaps it may have on the gas bacillus.

Silver is thought by some to have an antiseptic effect. Salts of aluminum we know have and aluminum is slowly dissolved by any alkaline fluid such as the blood.

I have recently obtained some enameled wire



such as is used for magnet coils. The best sizes to use are Nos. 26 and 28. The smaller sizes make more flexible drains than does rubber. They have a larger lumen for the external diameter. This wire seems to me to be ideal for the purpose. It costs at present about as much per pound as silver wire does per ounce. The copper wire is covered with a dense layer of cellulose such as artificial silk is made of. It is perfectly smooth, non hygroscopic and not acted on by weak acids or alkalis. Neither turpentine nor gasoline affect it. It may be subjected to a temperature of 600 degrees Fahrenheit without detriment. It may be boiled for any reasonable time without injury as instruments are. I believe it is as innocuous to the tissues as silk worm gut.

Iron wire may be used. I have used the wire from an old broom wrapped on a lead pencil. The drains can be made by any one anywhere. They can be wrapped on tool steel rods or on knitting needles. A lathe will do the work rapidly. A bandage roller or an ordinary brace fixed on a box can be used very well.

If a number of steel rods of various sizes have about 1/2 inch on one end made of a uniform size they may be inserted in a hole in a bandage roller and utilized to wrap the wire. Convalescent patients could do the work.

These tubes may be inserted say through a bullet wound in the thigh by placing a copper rod in the spiral to project just beyond the end. This rod may now be bent to any desired curve and inserted entirely through the wound or only to the bottom. The rod is withdrawn leaving the tube. A copper or aluminum wire is better than steel as it may be bent.

If the tip of the rod could be placed just into a cavity the drain could be pushed off of the rod deeper into the cavity.

This drain might be introduced into a tortuous channel where no rubber or other drain could possibly be placed. Possibly in this way some cavities about the head as the frontal sinuses or the Eustachian tube may be drained.

The wire from the buried end of the spiral is brought out through the tube the tube may be unwound from its buried end and so shortened from the bottom of the cavity. If 2 inches of wire corresponds to 1/2 inch of length then pulling out 2 inches will raise the end of the tube

1/4 inch from the bottom of the cavity. This can be done daily until the whole tube is unwound. The tube does not rub the tissues as it would if withdrawn.

The upper end may be fastened to the skin or a safety pin used.

These tubes may be made in sizes from 1/8 inch down to the size of a small knitting needle.

It is necessary that one end of the wire of a drain should be passed through the drain. A drain may be strengthened at its outer end by wrapping back over the steel rod for about one fourth inch then making a small loop by twisting a portion of the wire. Now lay this loop along the reinforced part and take a few turns of wire over it. The drain is now fastened to the skin by means of a safety pin through this loop and the skin or by a stitch.

I believe in practice it would be well to have a strip of sheet metal bent into the shape of a tube but not completely closed on the side to contain the tubes as they are easily deformed. The container with the tube could be placed with the instruments and boiled and the spiral removed when needed. These containers of thin copper or aluminum would be very inexpensive.

As my work is almost exclusively gynecologic and hence confined to the pelvis and abdomen I have little opportunity to try these drains but have used them in a few cases of pelvic abscesses with success. On this account I hope that I may be excused for making almost a purely theoretical offering to the profession. I have never seen in print or heard of any one using such drains so it may be possible that my suggestion is original.

Since writing the above I have used the enameled wire drain a number of times and find it perfectly innocuous to the tissues. N. B. Carson of this city who is well known to the surgical profession has used the drain extensively and finds it entirely satisfactory. It does not absorb fluids and gases nor injure tissues as rubber tube drains do.

There are some samples of enameled wire on the market which do not stand boiling. Perhaps the true cellulose covered wire which the books on electrical supplies describe is not obtainable. If the samples obtainable here are not cellulose covered they seem to be just as serviceable if not subjected to an oil solvent or boiled too long.

## MEDICINAL TREATMENT OF AMOEBIC ABSCESS OF THE LIVER

By WILLIAM ALLAN M D CHARLOTTE, NORTH CAROLINA

UP to about a decade ago tropical or amoebic abscess of the liver was one of the most serious maladies of tropical and warm temperate countries showing a mortality in untreated cases of 75 per cent (1) Under the purely surgical treatment of incision evacuation and drainage there followed an average case mortality of about 60 per cent (2) This frightful mortality following surgical interference is not surprising when the pathology of the lesion is considered There is of course no abscess wall or inflammatory barrier but an irregular advance of the invading organisms leaving coagulation necrosis and thrombosis of the blood vessels in their wake While evacuation of the contents will put an end to absorption and fever it may have not the slightest effect on the progress of the necrosis and open drainage will often superimpose a pyogenic infection Thurston (3) in 1914 reported 100 cases of liver abscess treated in various ways and concluded that incision with drainage had become an obsolete procedure in the proper handling of these cases

Aspiration of the abscess without drainage came as the next step in advance and brought a considerable reduction in mortality probably chiefly by preventing subsequent pyogenic infection As early as 1892 E Lawrie (4) cured 15 out of 18 cases of liver abscess by repeated aspiration without drainage and Cantlie (5) using Manson's method of closed continuous siphon drainage had 82 recoveries in 100 cases The advantage of aspiration over open drainage is even more strikingly shown by Chaterius (6) figures in his series of 48 cases in 15 cases opened and drained the mortality was 60 per cent while in 33 cases treated by aspiration the mortality was only 6 per cent

The injection of 2 per cent quinine solution into the abscess cavity after aspiration as recommended by Rogers has proved to be of doubtful value

About ten years ago due mainly to the efforts of Rogers in India, the use of ipecacuanha became a routine measure in all cases of amoebic abscess of the liver regardless of what method of emptying the cavity was to be employed This proved to be the greatest advance yet made in the treatment of this malady for within two years after its general adoption by the British Army in India the admission rate for liver abscess fell from 2.4 to

1.4 per 1,000 troops and the death rate from 1.3 to 0.48 per 1000 troops and the case mortality from 54 to 34.3 per cent (7) In Thurston's series (3) of cases the mortality fell from 40 per cent in those treated by surgery alone to 28.6 per cent in those cases in which ipecac was combined with surgery The verdict in favor of this drug as a cure for amoebic hepatitis as a preventive of abscess formation and as a *sine qua non* in any treatment of existing abscess has become unanimous (8)

The substitution of emetine for crude ipecac has marked as great an advance in the treatment of liver abscess as in the treatment of amoebic dysentery and its use is now a matter of routine, whatever other measures are adopted The literature is full of reports of chronic abscess discharging through the lung, that were speedily dried up by its use and the fact that emetine shortens remarkably the drainage time after open operation is undisputed

This success with emetine has naturally given rise to the hope of abolishing surgery entirely in the treatment of amoebic liver abscess But, strange as it may seem in the vast majority of cases reported since emetine was introduced, surgical measures have preceded or have been simultaneous with the use of emetine very little effort apparently having been made to determine what medicinal treatment alone will accomplish A few scattered instances of both success and failure with the drug alone are reported but only Dopfer (9) seems to have attacked this specific problem He is quoted as being convinced that evacuation of these abscesses is absolutely necessary The emetine converts the abscess into a dead one that is to say it kills the amoeba and prevents the further production of pus but is powerless to effect the absorption of the pus already formed

As my experience in three recent cases has been directly the reverse of that reported by Dopfer these cases should be of interest at the present time

CASE 1. White male age 30 seen January 11 1915 with Dr E C Boyette The present illness had started five weeks previously with fever and pain in the region of the gall bladder The patient had had fever daily in the meantime and for the past week had been somewhat jaundiced Pulse 80 temperature 99 leucocyte count 22,000 with 85 per cent polymorphs Physical examination revealed liver dullness up to the fourth rib in front

and up to the angle of the scapula behind the lower border of the liver, as 1 1/2 inches below the costal margin. The loss in weight had been 40 pounds. There had been no loose bowels with the present illness but in August 1904 there had been painful bloody dysentery for 2 weeks. The urine showed no trace of bile and the feces contained streaks of bloody mucus, the monads and pathogenic entamoebae. Patient admitted to Presbyterian Hospital January 14 and given emetine 1/2 gr. (1/2 gr. emetine 7 and 8 gr. on January 5 and 6 grs. 5 on January 7 and 8 gr. 5 on January 9 and 10 and gr. on January 11 and 12.

The temperature subsided by the fifth day and on January 14 the man was discharged. His jaundice had cleared up but the boundaries of his liver were enlarged. He reported 1/2 gr. 5 the gain of 3 pounds in flesh and the boundaries normal. During the 1 1/2 years there has been a number of recurrences of the dysentery but no recurrence of the liver abscess.

CASE 2. White male age 30 seen by Dr. C. C. M. M. on May 1, 1906. The patient gave history of attacks of chills and fever for the past fifteen years, some now on about every month and last 1/2 year in 1 month. After months of chills and fever, he felt pain in gall bladder, the stones removed and free from attack for a while after removal. Had chills and fever for 3 weeks during January 1906 and the present attack had already lasted ten days. Chills and fever at night and during the day, but not during the day. He has had no pain but is going about the usual day. During the present attack he has been ill for 4 to 6 stools, dry, but during the attack the nearest he has ever come to defecation is a half retort. He has always been constipated during his attacks. He never has loose bowels but sometimes has a loose stool. Examination revealed nothing except enlargement of the right lobe of the liver down and to the right of the border of the liver normal. The lower right lung during the present illness has been 8 pounds. When it was taken at noon May 1, pulse 88, temperature up to 101.2, blood 100,000 with 80 per cent polynuclears, no plasma. Urine normal. Feces contained pathogenic entamoebae. May 9, chills 1:40 p.m., fever 101.2, M. V. 11 at noon, fever 101.6, M. V. 11, no chills. May 11, chills 1:40 p.m. and second 1:40 p.m. The temperature was given emetine 1/2 gr. and this was repeated for ten days. There are no more chills after the first 10 days of emetine. January 6, 1907. No recurrence of liver abscess.

CASE 3. White male age 37 seen by Dr. J. J. Jan on September 9, 1906. The patient had been having chills, fever, sweats, cough and diarrhoea for three weeks. Temperature 101.8, pulse 100, haemoglobin 4,000, haemoglobin 88 per cent polynuclears, no plasma. There had been some pain over the upper abdomen and the epigastrium was bulging, symmetrical, smooth, dull on percussion, tender and looked as though a large grapefruit had been slipped under the end of the sternum and the costal arch. Physical examination otherwise negative. Urine normal.

Persons who had been entombed in the emetine gr. 1 was given daily for eight days and by the third day the temperature had subsided and the pain disappeared. The patient reported October 9, 1906, perfectly normal left lobe of the liver, far as percussion and palpation could determine and the gain of 30 pounds in weight.

Spittels' (10) observation is interesting in this connection. He reports a case of liver abscess which was aspirated, then opened and drained, and the patient given emetine 1/2 gr. for five days. The drainage tubes were accidentally removed and the patient died on the nineteenth day from general peritonitis. The autopsy showed that several separate foci of pus had been rendered inert and crystallized into solid, buff colored clots which disclosed microscopically the very large masses of fibrous and also discolored rapidly advancing fibrosis three fourths of an inch thick in the wall of the cavity. The size of the cavity had shrunk from one and a half pints to four ounces in the 19 days since operation.

The urgent need of an adequate medical treatment for those cases in which multiple abscesses are present is too obvious to require elaboration.

We shall probably always encounter some abscesses too large to be absorbed and in these cases aspiration is indicated, not only after the amoebic process has been stopped with emetine. In view of Spittels' observation and the cases cited above it is evident that the small and moderately large abscesses can be cured by emetine alone in a certain percentage of cases. Only considerable future observation will show how large this percentage will prove to be.

## REFERENCES

- |            |                         |               |             |
|------------|-------------------------|---------------|-------------|
| M. S.      | See 1                   | Drop 1/2 Dose | 005 4th ed  |
| K. P. 509  | L. F. Er                | il Frey       | d d         |
| p 35       |                         |               |             |
| 3. TUC     | 1 O 1 1 M C             |               | 4 1 95      |
| 4. ROK     | as L F Er in th Trox    |               | p 15        |
| 5. Jax     | p 383                   |               |             |
| 6. C.      | K. K.                   | Ind an M C    | 0 4 1 9     |
| 7. PILGRIM | H. W.                   | Ind an M C    | 1 31        |
| 8. CURE    | L. D. W. D. R. I. J. C. | x J F N R     |             |
|            | A. H.                   | Ind M C 22 9  | 1 0         |
| 9. DORT    | CASAS                   | Par ned       | 0 43        |
|            | Abat F p J              | B. H.         | 4           |
| SPITTELL   | R. I.                   | Brit M J      | 9 3 Oct 1 8 |

## TWO FRACTURE DEVICES

BY J E CANNADAY M D F A C S AND H D HATTIELD M D F A C S CHARLESTON WEST VIRGINIA

**I**N our fracture service we have found the two types of fracture apparatus described below to be simple economical and efficient, and we believe them to be desirable additions to the fracture armamentarium.

The first (Figs 1, 2 and 4) is an extension apparatus intended for use in conjunction with a plaster cast. This device consists primarily of a light bronze aeroplane turnbuckle to each end of which an anchor has been solidly fitted by a blacksmith or machinist. These anchors are roughly in the shape of a cross, the long end of which a short distance above the cross bar is bent outward at right angles so as to engage the eye which protrudes at either end of the turnbuckle. It is solidly riveted into this eye so there will be no rocking or lateral motion. These turnbuckles have a spread of two inches or more. In the treatment of the usual fracture of the arm or leg three of the above described units are used. These are spaced so that one is on either side and one anteriorly.

To apply this apparatus the fractured limb is first carefully protected over all bony prominences with cotton batting or absorbent cotton and flannel bandages. A light plaster cast is applied and allowed to partially harden. The extension apparatus is applied over this. The anchor ends are secured by a few additional turns of plaster bandage. As soon as this has hardened sufficiently for the anchors to be held securely in place the cast encircling the limb is sawed in two with a keyhole saw at a point about the center of the turnbuckle. The extension can be made immediately up to the point of tolerance of the pa-

tient. These turnbuckles are perforated near the center for the insertion of the key used in extending or shortening the turnbuckle. If the surgeon desires to avoid needless meddling with the apparatus a small wire can be passed through the perforation at the center of each extension piece and the ends secured by a small lead seal such as is used in sealing cars.

In securing extension below the knee good resistance against the pressure of the cast can be obtained by having the knee well fixed before the application of the cast which extends well up on the thigh. If applied to the forearm the pressure is made against the sides of the hand at one end and the flexed upper arm at the other. When the humerus is broken extension can be made against the side of the chest with the arm extended at almost a right angle from the shoulder and against the flexed forearm. If the fracture is in the thigh, the pressure is made against the pelvis above and is secured by the flexed leg below.

This means of extension is very effective in comminuted fractures if applied early before strong muscular contraction has taken place. Wounds of the soft parts can be readily dressed through windows cut in the cast. The separated sawed ends of the cast need not be at the point of fracture. The extension is constant and can be easily regulated.

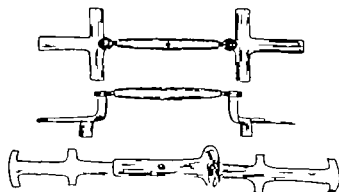


Fig 1 (above)  
Fig 2  
Fig 3

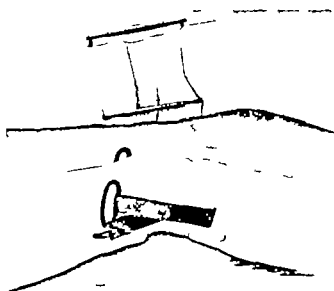


Fig 4 (above)  
Fig 5

The second apparatus (Figs 3 and 3<sub>a</sub>) consists of a special hinge for the knee. Two of these units may be used when it becomes necessary to include the knee in a plaster cast in the treatment of fractures of the femur or tibia. This hinge can be made by any good blacksmith. It has a simple locking device which consists of a short pin which works in a slot. The hinge can be secured at any point by tightening a thumb screw. The anchors of this hinge are four inches or more in length in order that they may be

firmly fixed in the plaster cast. This hinge apparatus is incorporated in the plaster cast in the same manner as the turnbuckle extension device. By the use of this hinge two pairs of which are used one on either side of the knee, the surgeon maintains relative immobility and extension and each day can loosen the locking device and give the joint passive motion thus preventing the undue amount of stiffness often seen in the knee joint after long absolute immobility in a plaster cast.

## CORRESPONDENCE

### NOTES FROM THE SURGEON-GENERAL'S OFFICE

*To the Editor.* Should the country ever be engaged in war the Medical Department of the Army in calling Reserve officers to the colors wishes to cause as little hardship and sacrifice to the Reserve medical officers as may be consistent with the needs of the country. With this end in view the Department desires that you bring to the attention of the profession at large the necessity of the city, county and state medical societies organizing for the purpose of taking care of the practices of the officers of the Reserve who respond to a call for service. In England this plan has proved of great benefit. The idea of the Department is that the profession should organize upon a similar basis.

For example, should Dr. Jones be called to the colors the local medical society through its members would take care of his practice during his absence. Upon relief from active duty his practice would be returned to him intact. Such a plan will cause no unnecessary hardship upon the officer responding to a call for service while the absence of such plan would penalize the officer who gives his service to the country in a crisis. The Department appeals to the patriotism of the profession to protect the interest of those of the profession who may be called to duty in war.

For the Surgeon General

ROBERT E. NOBLE

Major Medical Corps U. S. Army

#### ARMY MEDICAL CORPS EXAMINATIONS

The Surgeon General of the Army announces that preliminary examinations for appointment of First Lieutenants in the Army Medical Corps will

be held at convenient points the first Monday in each month. Full information concerning these examinations can be procured upon application to the Surgeon General U. S. Army Washington D. C.

The essential requirements to secure an invitation are that the applicant shall be a citizen of the United States shall be between 21 and 35 years of age at the time of commission at the close of the Army Medical School a graduate of a medical school legally authorized to confer the degree of Doctor of Medicine shall be of good moral character and habits and shall have had at least one year's hospital training as interne after graduation.

Graduate physicians who are serving their internship and who meet the other requirements can be examined for appointment with the understanding that they will complete the required postgraduate hospital internship before coming to the Army Medical School.

Those who qualify at their preliminary examination and complete their hospital internship by July first will be ordered to the Army Medical School for the special session of the school commencing July 9. The regular session of the school will open on October 1.

In order to perfect all arrangements for the examination applications should be completed at the earliest practicable date.

There are at present 330 vacancies in the Army Medical Corps.

After July there will be 32 additional vacancies.

# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD FRIDAY EVENING NOVEMBER 17 1916 WITH THE PRESIDENT  
DR CHANNING W BARRETT IN THE CHAIR

### EARLY ECTOPIC PREGNANCY TUBULAR VARIETY

DR W A NEWMAN DORLAND reported a case and presented a specimen of very early ectopic pregnancy of the tubal variety with the following history. The woman menstruated October 1 for three days. The November menses were missed. On November 10 she suffered an attack of colic on the right side and fainted. Dr Norman Kerr who was called in, pronounced it either appendicitis or tubal pregnancy. The patient experienced a second attack of pain in the afternoon of that day and on Sunday morning two days later had a third attack. A diagnosis of ectopic pregnancy was made and immediate operation advised. I saw the patient on the afternoon of November 12 and agreed in the diagnosis with Dr Kerr. I operated on the case Tuesday morning November 14. At first I thought it was merely an intra uterine pregnancy as there was no sign of pathology and only a moderate uterine enlargement. A foreign body was felt in the tube however which was removed. There were no adhesions around the tube nor what is still more interesting was there any hemorrhage into the peritoneal cavity.

On carefully incising the upper margin of the resected tube the tiny gestation sac was revealed. This is probably as early a case of tubal gestation as that recently reported by Bandler of New York which he claimed was probably not older than ten days.

### DISCUSSION

DR MAXMILLIAN HERZOG. This is probably a very young ectopic gestation (referring to the gestation sac) but to judge of its age sectioning would be necessary. It may be young or not. The age can be accurately determined by an examination of the embryo if that has been preserved. If not preserved the age can be approximately determined by the villi although sometimes their appearances are deceptive. I have had several of that kind one almost as small as this but in no case could I find the embryo.

DR DORLAND. In order to show this interesting specimen to the society the case was presented before sectioning was done. That will however be done at an early date.

### DIFFICULT DELIVERY OF SHOULDERS

DR JOSEPH B DE LEE presented the report of a case as follows.

A woman with a contracted pelvis who had had difficult labors before and who always presented great difficulty in the delivery of the shoulders went into labor a few days ago. The child was larger than her other children and the shoulders remained above the inlet and could not be brought down. I attempted to break the baby's clavicle but could not do so. I tried to pull down the arm with brute force, hoping to break the humerus but failed. The baby began to gasp but it could not get any air into the lungs. The idea occurred to me to insufflate the baby's chest still held in the uterus so I passed a catheter into its trachea and aspirated a little mucus from the windpipe and performed artificial respiration by mouth to mouth insufflation, the child's chest being above the superior strait. Only a small amount of air could get in but it was sufficient to keep the child alive. I was very deliberate in the subsequent process of delivery which required eight or ten minutes during which time the catheter was in the baby's lungs and the air could be heard going in and coming out.

I recommend this method for more general application and I hope it will save some babies who might otherwise be lost. With more experience I think one could catheterize the baby's lungs after breech delivery with arrested head.

Finding that I had plenty of time I succeeded in delivering the baby by gradually molding by combined external pressure and internal traction the shoulders to the passage bringing down one arm with great deliberation, then the other arm thus delivering a child that was gasping through a tube but uninjured with no Erb's paralysis and no fracture. The weight of the baby was eight pounds and eight ounces. The pelvis was generally contracted with a conjugata vera of 9 cm.

### PORRO OPERATION FOR FIBROID COMPLICATING PREGNANCY

DR A J SCHOENBERG reported a case of Porro operation for fibroid complicating pregnancy and exhibited a specimen (Fig 1).

The patient from whom this specimen was re-

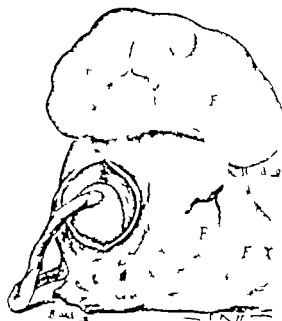


Fig. D. Schoenberg. Case of fibroid complicating pregnancy.

moved was a Swedish woman 37 years of age. Family history negative, mother still living and well. Personal history negative with the exception that she had always been constipated and was never very strong. She began to menstruate at 3, always regular, 8 day type, moderate in amount and lasting 3 to 4 days. This was the first pregnancy she had been married one year. For the past two years she has had more or less pain in the lower abdomen.

Early in October, 1905, she began to have morning sickness and suspected pregnancy. She menstruated at her regular period in September and October but in November the menses did not appear. Pains gradually increased and were so severe that at times she could hardly walk.

January 1, 1906, she consulted a physician who informed her that she had a water tumor and advised immediate operation for its removal. She however decided not to be operated on soon thereafter she thought she felt quickening. In February she consulted a midwife who after looking her over advised that she go to a physician.

Early in May she consulted another physician who diagnosed a possible twin pregnancy and accepted the case on condition that she go to a hospital. The probable date of confinement was computed to be about June 30. On June 8 she was thought to be in labor and was sent to the Evangelical Deaconess Hospital. The pains subsided the following day and she returned home but the pains soon recurred and continued until Saturday, June 24, when she again was taken to the hospital.

She had been having very severe pains during her stay at home from June 19 to 24, at times she rolled and writhed in pain lying on the floor.

The writer was called to see the case Saturday, June 24. Examination at that time revealed a rather poorly nourished woman showing evidences of exhaustion, no marked increase in pulse rate, heart and lungs negative. The abdomen was irregularly and asymmetrically enlarged. A large tumor, as felt: the upper abdomen and another in the side, feeling not unlike a fetal head. The vaginal examination showed the vulva and vagina to be normal except for the congestion due to pregnancy. External os not dilated, cervix only partly effaced, vertex presentation. Fetal heart sounds could be elicited but were rapid and weak.

Diagnosis: single pregnancy with multiple fibromyomata.

Because of long labor and no engagement indicating lack of a lability of the child's head to the pelvic outlet, delivery by the normal route was impracticable. Immediate cesarean section was therefore decided upon. This offered immediate relief for the mother, the best possible chance for the child, and an opportunity to deal with the fibroids as the conditions demanded. The abdomen was quickly opened and the large tumors could be seen. The uterus was rotated and studied. An incision was made with its middle slightly below the navel, a foot sought and a rather poorly nourished child delivered and resuscitated after some effort. Hysterectomy was then decided upon for the reason that it was necessary to remove the tumors, myomectomy being impracticable, hemorrhage was possible and infection feared. The specimen shows that myomectomy would have been a very serious undertaking. The uterus was at once raised out of the abdomen, clamps applied to the broad ligaments and the uterus with its tumors removed. The ovaries were found to be healthy and were left. A gauze drain was passed through the cervix into the vagina, the round and broad ligaments sutured to each side of the cervix and the stumps covered over with the anterior and posterior flaps of peritoneum. The child weighed 5 pounds and 2 ounces. The mother convalesced without untoward symptoms, both going home on the twentieth day after operation. Four and one half months after birth both mother and child were well.

The specimen shows multiple fibroid nodules, varying in size, the largest of which was about the size of a man's head. The measurement from above downward was 36 centimeters, anteroposteriorly 15 centimeters, side to side 18 centimeters, weight 5,000 grams or 11 pounds. The gross specimen on section shows that the largest intramural fibroid has undergone myxomatous degeneration.

The result obtained in this case strongly emphasizes the fact that fibroid tumors of the uterus associated with pregnancy should not be interfered with during pregnancy except as symptoms force interference. It further emphasizes the desirability

of giving a woman with fibroids an opportunity to become pregnant before a radical operation is performed unless the symptoms are urgent

## DISCUSSION

DR DOEDERLEIN I am reminded of a case of a tumor of about a half term pregnancy. The tumor was a so called adenoma of Hartsell and the pregnancy occurred inside of the tumor as determined by microscopical section. I think now that we have a fourth type of ectopic pregnancy in addition to the present three recognized types namely the primary tubal, the primary ovarian and the primary abdominal.

DR EUGENE CARY I would like to report the case of a woman whom I saw when four months pregnant. At that time a diagnosis of uterine fi-

broid was made. One fibroid was about as large as the fist and lay in the right uterine segment. As the pregnancy progressed the fibroids could be grasped through the abdominal wall with the fingers. The diagnosis of tumor in the uterine wall was concurred in by four men. As the pregnancy progressed to term these fibroid masses became softer and cystic. The woman was delivered spontaneously with only slight subsequent hemorrhage. On palpating the relaxed abdomen after delivery no fibroids were palpable.

## THE PATHOLOGY OF LATENT SYPHILIS

DR A S WARTHIN University of Michigan, presented (by invitation) a paper on The Pathology of Latent Syphilis

## CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 8 1916 WITH THE PRESIDENT DR WILLIAM M HARSHA IN THE CHAIR

## ARTHROPLASTY ON THE ELBOW JOINT

DR SAMUEL C PLUMMER I wish to present a case upon which arthroplasty of the elbow joint was done. Before operation the arm was flexed 15 or 20 degrees and there was no motion whatever in the joint. The patient fell and suffered compound fractures of the femur and also of the humerus near the elbow joint. Infections developed in both of these fractures. Union did not occur in the femur. The patient had a bad luetic history and poor nutrition. Even though several operations were done there was failure to secure union of the femur and finally the thigh was amputated at the upper third. Three years after injury he came for operation on the elbow. The position of the arm rendered it about as useless as an arm could be. He could not get his hand into the pocket of his trousers, and although a bad operative risk I took a chance on an arthroplasty. I found there was absolutely no sign of any joint between the humerus and radius and ulna. It seemed to be a solid bone. There was no joint surface left anywhere, no sign of a joint. I took away a liberal portion of the bone and turned in pedicle flaps of fat and fascia from the neighborhood and as these were not sufficient I took a free flap to cover up what could not be covered by the pedicled flaps. Unfortunately he developed an infection, the wound suppurated, a sinus remained and in the course of time I found I had necrosis of the humerus. So an other operation was done and quite a portion of the end of the humerus at least three quarters of an inch was taken out. With the infection and necrosis I was afraid the operation was going to be a failure and we would get ankylosis of the bone again. But

at the time of the removal of the necrosed humerus I found there was a fibrous layer covering the ends of the bones of the forearm and I felt sure from that there would not be union again of bones. On account of so much more bone being gone than I intended to take out in the first place I did not know what function he would get.

He had another untoward circumstance in connection with this. Although I have had some experience with paralysis of nerves from the Esmarch, I thought I had taken every necessary precaution in this case. Before the Esmarch was put around the arm I folded a towel around the arm and thought the nerves were safe. After the operation I found total paralysis of the nerves below the Esmarch. Every nerve was paralyzed. In the case of the ulnar nerve, I dissected that out first and kept it out of the way. I know I did not injure it in the operation. It was not long before he began to get some return of nerve function, and now he has made practically a recovery. The only thing he complains of is a little anasthesia of the little finger and next finger where the ulnar nerve is distributed. Of course, the muscles of the arm were very much atrophied from three years of non use but he has been developing them. He can now put his arm away around his shoulder and up behind his head and back of his neck. He can overextend it a little. The functional result is very good and very satisfactory.

You will perhaps remember that at one of the clinical meetings held in St. Luke's Hospital about a year ago I showed another case of arthroplasty. That was a case of a boy of ten who had a fracture of the lower end of the humerus. There was anky-



louis and I operated on him when he was sixteen. He has grown up to be man size since he had this ankylosis and his muscles were very much undeveloped as well as inactive from non use. Although he had good motion his facility for moving the joint was not very good. He studied wireless telegraphy and I received a postal card from him recently from the West Indies saying he was getting stronger every day and was able to fill the position of wireless telegrapher which he could not have done with the elbow ankylosed in the same position this one was. In that case there was joint surface between the radius and ulna and between the upper end of the radius and articular portion of the humerus which articulates with the radius but the ulna and humerus were as one solid bone.

## SYMPOSIUM ON MILITARY SURGERY

Dr. JACOB FRANK, Lt. Colonel Surgeon General of the State of Illinois gave a talk on his Experiences as Chief Surgeon in a Mobilization Camp.

Dr. H. M. RICHTER, Chief Surgeon Base Hospital at Naumburg on the Saale read a paper entitled General Considerations of Service with the Central Powers.

Dr. C. G. DAIS, Lt. Colonel R. A. M. C. followed with a paper entitled Surgical Impressions of Service with the British Expeditionary Forces in France.

Dr. KELLOGG SPEED, Lt. Colonel R. A. M. C. read a paper entitled Observations of a Senior Surgeon Commanding the Surgical Division of a British Base Hospital in France. (See p. 454.)

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review, the interests of our readers and as space permits.

A REFERENCE HANDBOOK OF THE MEDICAL SCIENCES, edited completely revised and rewritten. Edited by Thomas Lathrop Stedman, A. M., M. D. Eight volumes. Vol. VII. P. S. No. New York: William Wood & Co. 1910.

THE BREAST: ITS ANOMALIES, ITS DISEASES, AND THEIR TREATMENT. By John B. Deaver, M. D., LL. D., Sc. D., and Joseph McFarland, M. D., Sc. D., assisted by J. Leon Herman, B. S., M. D. Philadelphia: J. B. Lippincott & Co. 1910.

THE NEWER METHODS OF BLOOD AND URINE CHEMISTRY. By R. B. H. Grubb, M. D., and A. J. Blasius, Sc. D. New York: C. V. Mosby Company. 1910.

MANUAL OF THERAPEUTIC EXERCISE AND MASSAGE, adapted for the use of physicians, students and masseurs. By C. Hermann Duchols, M. D. Philadelphia and New York: Lea & Febiger. 1910.

PREVENTIVE MEDICINE AND HYGIENE, edited thoroughly revised. By Milton J. Rosen, N. York and London: D. Appleton & Company. 1910.

THE DISEASES OF INFANCY AND CHILDHOOD FOR THE USE OF STUDENTS AND PRACTITIONERS OF MEDICINE, 7th ed., fully revised. By L. Emmett Holt, M. D., Sc. D., LL. D., and John H. Land, A. M., M. D. New York and London: D. Appleton & Co. 1910.

MY BIRTH. By Armenhouse T. Lamson. New York: The Macmillan Company. 1910.

BETTER BABIES. By Samuel A. Varsana, Ph. G., M. D. Atlanta, Ga.: Foote & Daes Company. 1910.

AN INQUIRY INTO THE PRINCIPLES OF TREATMENT OF BROKEN LIMBS. PHILOSOPHICO-SURGICAL ESSAY WITH SURGICAL NOTES. By William I. Huhner, M. D. New York: The Robson Company. 1910.

THE DIAGNOSIS AND TREATMENT OF ABNORMALITIES OF MYOCARDIAL FUNCTION, WITH SPECIAL REFERENCE TO THE USE OF GRAPHIC METHODS. By T. Stewart Hart, A. M., M. D. New York: The Robson Company. 1910.

CLINICAL GYNECOLOGY. By James C. Wood, A. M., M. D., F. A. C. S. Philadelphia: Boerck & Tafel. 1910.

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXIV

MAY 1917

NUMBER 5

## HYPOSPADIAS AND ITS TREATMENT

By CARL BECK, M.D., F.A.C.S., CHICAGO

PLASTIC surgery is a specialty. It does not appeal to every surgeon. It requires more ingenuity and originality during the operation than any other branch of surgery. There is less reliance and less following of a typical method of procedure. There is more demand for exact technique. Plastic surgery demands a great deal of patience and close attention during the after treatment. It is attended with more failures than other surgical operations but has attracted some surgeons in the highest degree and if successful is highly gratifying. It is a hobby.

My old friend Professor Senn was a great enthusiastic plastic surgeon. He would leave everything else to do an extensive difficult plastic. Such names as Dieffenbach, Duplay, Lauenstein, Langenbeck, Thiersch and Tuffier are heard whenever plastic surgery is discussed. I have always liked it and through my numerous articles on the subject and demonstration of cases before medical societies I have had much plastic work referred to me. Thus I have acquired a great deal of special knowledge in such work and have gradually accumulated a considerable amount of material so that I have been tempted to write a book on plastic surgery. When I was about to compile my book and to sift and select the matter grew enormous, particularly in the illustrative part and I had to abandon the task as too great for the

present. Instead I selected some groups of plastic surgery cases which are rarer, less studied and less developed than others and I treated them in a small monograph. I hope that this contribution will help those surgeons who are interested in the cure of hypospadias.

Our most elaborate textbooks are rather inaccurate and unattractive in the chapters dealing with plastic surgery. Particularly to the surgeon they do not offer much help if he is seeking information as to how to treat successfully a case of hypospadias. The abnormalities of the genital organs offer the least attraction of all plastic work and one may safely say that even in the hands of competent surgeons some patients who undergo such procedures are in worse condition after than before treatment.

Through the relatively great amount of material comprising more than 60 cases I have gradually in the course of twenty five years developed methods which yield to me a lasting success and I believe therefore that this detailed treatise will offer some good advice to those who wish to do such work. I do not treat epispadias at the same time I treat hypospadias although the two conditions are closely related and there are many similar methods of treating them. I do not treat them at the same time because I think epispadias except in very rare instances has only a theoretical interest.

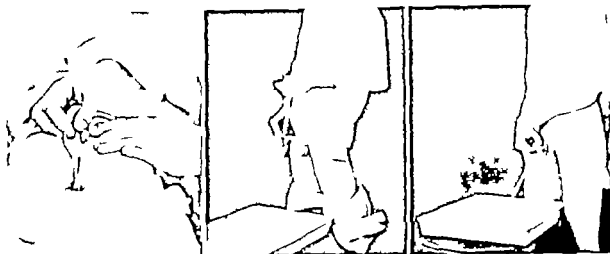


Fig. 1. A high degree of hypoplasia of the urethra. (Personal observation.) Fig. 2. Method of trying to produce a stream of urine by squeezing of the scrotum. (Personal observation.) Fig. 3. Cure of the retraction of the urethra. (Personal observation.)

#### HISTORICAL

While the abnormalities of hypospadias and epispadias were known even in classical times it is only of late that particular attention has been given the subject by the surgeon. If one looks through the literature on the subject he observes immediately that 90 per cent and more of it belongs to our present time and is written after 1900. This is due not only to the fact that medical literature is more extensive now and more general but also to the fact that the subject has gained more favor with surgeons.

The term hypospadias was created by Galenus. Paulus of Aegina and Albucasis have given a good description of this condition treating it as a curiosity. There are reports of cases in the older literature by Blasius Stalpart Vanderwiel and others but the descriptions are in the style of those times incorrect.

The first well observed cases are described by Morgagni in his work *De Sedibus et Causis Epistolarum* and he also is the first one to give an accurate opinion as to the origin of this condition attributing it to arrested development.

In the nineteenth century a number of

authors in Germany and France wrote a great deal on hermaphroditism often mistaking it for cases of hypospadias. Both of these abnormalities have often been misinterpreted hypospadias taken for hermaphroditism and vice versa. It was in 1861 that Bouisson in a monograph considered hypospadias with regard to surgical operation and in the following years of 1863 and 1865 Guyon the celebrated French surgeon and urologist wrote a treatise on this subject in a modern scientific style and brought hermaphroditism and hypospadias into their proper relation. From that time on dates really most of the scientific work on these pathologic conditions. Since Guyon's time operations have been performed for hypospadias. Statistics as to frequency of the condition have been collected. Bouisson found for instance among 300 soldiers 1 case. In 1880 Rennes counted among 3000 individuals only 10 cases of hypospadias (one to three hundred). It was also established by these early writers that heredity plays its part in this condition. A French author for instance Eugène Frank found this abnormality in every member of a family in several generations while Lepelletier relates the case of two brothers with



Fig 4

Fig 4. Case showing deep scrotal hypospadias. The black opening in the center is the external urethral opening. The ridge from this opening to the false opening in the glans is the very shortened urethra. This case also shows the bifurcation of the acrotum. (Personal observation.)



Fig 5

Fig 5. The same case as it appears from the side showing the large size of available prepuce for plastic.



Fig 6

Fig 6. A case of genital aplasia with hermaphroditism. In this case the urethra is to be seen at the end of a false groove in a clitoris. This opening also leads to a very narrow opening into the vagina. (Personal observation.)

scrotal hypospadias.<sup>1</sup> Bouisson reports an observation of Parhier from the University Montpellier that the abnormality was caused by intermarriage. Such were the opinions of the early observers.

The first intelligent views however have been introduced into this subject by the studies of embryology which finally disposed of all the vague opinions in regard to the cause. There is a number of men whose names are always mentioned when this deformity is discussed. These men have written more than others on the subject. In the early times it was Lauenstein of Hamburg, Duplay of Paris and before them Dieffenbach, the universal surgical genius of his time who made plastic surgery a field of special study. Since 1900 it is principally Hacker, Tuffier, Novak, Josselyn and Schmieden and Carl Beck, who have given to this subject a great deal of consideration, but a large number of prominent surgeons of our time have published observations in regard to the same and the literature up to this day has become very voluminous. In the book on

*Results of Surgery and Orthopedics* published by Payr and Kuettner in 1913, Hugo Stettiner gives an exact comprehensive article on epispadias and hypospadias with a number of instructive illustrations and particularly a detailed description of the transplantation of the vein to form a urethra.

It seems to me however that in giving the history and development of methods, one comes to the conclusion that at this time the experimental stage is passed. On giving the description of my own method, I can say that anatomical conditions are almost restored to normal by the operation and physiologically there are no abnormal symptoms present after the cure. In reviewing the methods of the different authors in the past and at the present time, one cannot help but make for most of them the following criticism: Most of the surgeons have had too little experience and have experimented too much with new modifications and schemes invented by themselves or suggested on account of previous failures. The first attempts must naturally be disappointing and as few surgeons have seen personally these operations performed by others, the operations must be done from theoretical knowledge only, which fact accounts for the many failures and modifications. In this respect I will mention an

<sup>1</sup> I have among my observations the instance of three brothers with scrotal hypospadias, of whom I have operated upon. The oldest one, 3 years old, referred to me some twelve years ago before I had developed good technique and it required several operations to get results. He was about 12 years old when he first consulted me. His younger brother came at the age of twenty-two and is now only partially cured. He has a false urethra, but the whole urethra is present. The third, a high school boy, now



Fig.

Fig. 1. A high degree of hyp  
mould development of the th  
rudition. Termination of eryt  
Fig. 2. Method of blood  
in urinal blood stream.

## HISTORICAL

While the abnormalities of hypospadias were known even in antiquity it is only of late that particular attention has been given the subject by the urologists. Looking through the literature one observes immediately that of the cases more of it belongs to our present time than to the past. This is due to the fact that medical literature has become more extensive now and more general. It is also due to the fact that the subject has been treated in favor with surgeons.

The term *hypospadias* was first given by Galenus. Paulus of Aegina has also given a good description of the condition, treating it as a curiosity. There are many cases in the older literature. Stalpart, Vanderwijel and other descriptions are in the style of the present, but incorrect.

The first well observed cases are given by Morgagni in his work *De Sedibus et Epistola*, and he also is the first to give an accurate opinion as to the condition, attributing it to arre-

In the nineteenth century





Figs 12 13 and 14 Results of author's operation showing the position and length of the urethra and perfectly freely moving pendulous part shortly after completion of the operation. In Fig 14 (at right) the stitches of the lateral flap are still visible.

difficult art to describe a method clearly and accurately.

The fault lies in the relatively small number of operations coming to one individual surgeon. I plead therefore that the physicians to whom these cases are brought for treatment should turn them over to those who make a specialty of such cases so that the patients may receive the benefit of experience and well defined and tried surgical treatment.

#### DEFINITION

Hypospadias is a maldevelopment of the urethra. It consists in the partial or total absence of a urethral canal and of the urethral tissues.

According to the degree of absence of the urethra we have a number of degrees of this maldevelopment but there are many complications which have a great practical significance.



Fig 15

Fig 15 Perforation of the glans preparatory to a plastic (removal of scrotum).



Fig 16



Fig 17

Figs 16 and 17 Two cases of case after first transplantation of prepuce upon frontal surface of urethra.

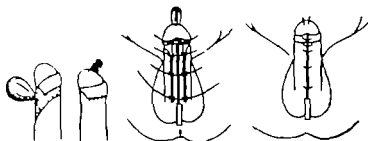


Fig. 8. Method of Hamilton R. II

## ETIOLOGY

The cause of the deformity is the same as in most malformations of the body. It is a lack of formation of normal structures or an arrest of development. If a cleft of the face of the embryo fails to unite in the regular normal fashion a harelip or a similar defect will result. This condition will persist through life. So it is with the urethra. It develops by the union of two halves of the embryonal structures and has its opening on the top of the glans penis directed forward so that in the act of urination the stream is projected in a shallow arch or in a straight line continuing in the direction of the urethra. Through the change of the caliber of the urethral canal and the difference in the folds of the same the urine is forced out in a spiral configuration which makes the urination more of an equal regular stream. When pathologic conditions like inflammation or stricture or other changes are present the stream of urine immediately changes into split or dribbling like or into other varieties. The same happens if the opening is not terminal but on the lower surface as in hypospadias. For the same reason the patient cannot urinate as a healthy individual does but often must squat down or sit down or manipulate the urethra to give the stream a straight direction etc (Figs 2 and 3).

At an early stage of the development of the embryo there is no distinction in the tissue between male and female. There is a depression at the lower end of the embryo which corresponds to the opening of the bowel and bladder the so called cloaca. This develops about the sixth week of the embryonal development. A ridge the so called genital

ridge rises very soon around the anterior portion of the depression and soon a prominence forms the so called genital eminence with a groove in the center. This groove seems to run into the depression which we have called cloaca. It soon becomes flanged by two ridges the genital fold on each side. The genital eminence becomes later in the male the penis in the female the clitoris with a portion at the end which is called glans in the male and female. While in the male it develops to large proportions it remains in the female very small and is covered up by the labia. At about the third month of development one can distinctly distinguish the male and the female embryo. From this period the development in both sexes differs considerably. In the male the genital prominence develops on both sides of the groove into the corpora cavernosa while the groove itself by closing in the median line and by becoming deeper forms the urethra. The genital folds which in the female remain distinct and separated become the labia and the nymphæ. They merge into each other with only a line and raphe between and become the scrotum in the male. This raphe cuts in more or less in individual cases and if it cuts in deeply the resemblance between scrotum and labia is very pronounced. The urethra opens in the center of the male glans. In the female the urethra opens just below the glans. The failure of union of the genital folds either wholly or in part results in total or in partial deficiency of the floor of the urethra and causes what is commonly called hypospadias (Fig 1).

Such a condition gives rise to a malformation which may simulate hermaphroditism

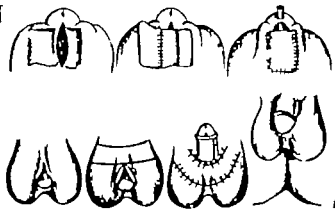


Fig. 19 Operation of Lauenstein with the formation of a bridge in the upper part a picture showing Thiersch operation

One can see from this description of the development of the organs that there is a great resemblance between the state of hermaphroditism and hypospadias (Figs 1 and 6). In reality most of the cases of excessive hypospadias are taken for hermaphroditism. There are many degrees of this deformity. Sometimes one sees a case in which the raphe of the scrotum cuts into the scrotum so deeply that it seems that each testicle has a scrotum of its own (Figs 4 and 7). In such cases the testicle often is unusually movable and slips up toward the inguinal canal so that the scrotal halves containing no testicle have a close resemblance to labia of the female. If in such cases the penis is small and resembles a clitoris (Fig. 1) and a hypospadias of high degree is present, the individual may pass early for a female even to the physician.

One of our patients, Mr. F., who was recently in our care and whose case we will describe more in detail, a gentleman who is now a university teacher had been in girl's clothes up to his nineteenth year and in a girls' college until the condition was recognized. The complication of hypospadias with rudimentary development of penis glans and corpora is the most important feature (Figs 4 and 5).

#### SYMPTOMS

The symptoms of hypospadias are of two kinds: (1) the physical (2) mental. There is no doubt that a large number of persons afflicted with this abnormality go through life without ever having any idea that they

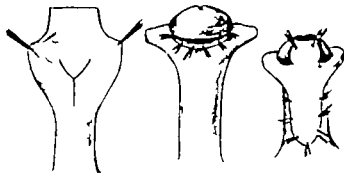


Fig. 20 The initial steps of the operation of Ombredanne (Stettiner)

are abnormal. They are individuals who never know that they may be different and therefore do not consider themselves abnormal or they are too ignorant to know anything at all about these conditions. Parents of some education and intelligence naturally pay more attention to such conditions than ignorant parents and children of better families therefore are more frequently brought to the physician on account of such abnormalities.

Sometimes they are brought at an early period of life even as infants. The parents are very much alarmed about these defects and of course urge surgical help. The second period in which the patients recognize symptoms is when they begin to go to school when they notice that if they would urinate while standing like their school mates they would soil their clothes. They are accustomed to squat down to urinate like girls. In this position it is easier for them to pass urine. They call the attention of their parents to this fact whereupon they often consult the physician. In some instances they are able through manipulation of the urethra, pulling it forward and thus straightening it to urinate in the normal fashion (see Figs. 2 and 3).

The third period in which patients afflicted with hypospadias become anxious about their defect is when they contemplate marriage. This is indeed the most common occasion to consult the surgeon. Besides the difficulty in urination, there is the moment of mental worry and disturbance connected with the thought and the consciousness of having a malformation which is to these patients a cause of concern and anxiety. Melancholia



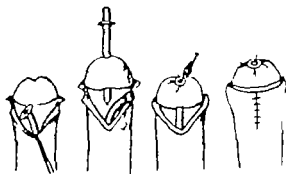


Fig. The Beck-Hacker operation

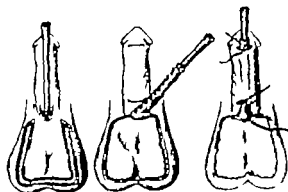


Fig. Beck-Rochet method

queer behavior in society and bashfulness are symptoms which do not allow some of the people afflicted with this abnormality to enjoy life. Sterility in married life is one of the symptoms which also brings some of the patients of maturer age to the observation of the surgeon. Impossibility of the coitus is also one of the complaints. This is an important symptom in which hinge the result and success of an operative cure. The urethra being absent or very deficient the corpora cavernosa do not attain normal erection because the glans and scrotum are tightly connected by a membrane or scarlike tissue (Figs. 4 and 5) and the corpora cavernosa form a curve or pruned angle in erection just as they do in case of a scar after an abscess or sometimes in an indurated stricture. This condition is often produced or made worse by the operation with certain methods as we shall see later on.

#### DIAGNOSIS

The diagnosis of hypospadias is at times simple at times however it is very difficult especially in younger individuals. A differential diagnosis in infants between a high degree of hypospadias and hermaphroditism may be almost impossible. Only the presence of a vagina and rectal examination may decide the nature of the abnormality. We also have to diagnose the degree of the abnormality. We distinguish three varieties which do not present distinct types but practically the most important and common cases. For the sake of a practical division which is anatomically more interesting than surgically

the varieties are summed up in three groups viz. the penile, scrotal and perineal hypospadias.

The penile is one in which the urethral orifice is on the lower surface of the penis and comprises all the degrees from the normal to those with the orifice on the border of the scrotum. In all the cases of distinct hypospadias there is however also a malformation of other structures of the penis i.e. the corpora cavernosa which are not so well developed. The urethra is absent or deficient to a certain degree. The abnormality is best shown in the erection through the scarlike contraction between glans and scrotum. This shortening and this traction in the erection is one of the symptoms in which most of the sufferers complain a great deal as we have already mentioned.

The slightest degree of abnormality in the penile variety of hypospadias is a variety which would pass almost as normal. The urethra is indicated by a blind depression the real orifice where the frenulum ought to be while the frenulum is missing (Figs. 7 and 8). Instead of the latter we find a tiny opening which if stretched shows that it is wider inside and continues into a more or less normal urethra. The prepuce in these cases is hanging over the glans like a curtain or a loose skin flap. Sometimes there are two or three small blind openings one back of the other lined with a reddish mucous membrane from which some mucus is easily discharged. These blind openings are only parts of the urethral mucous membrane separated en

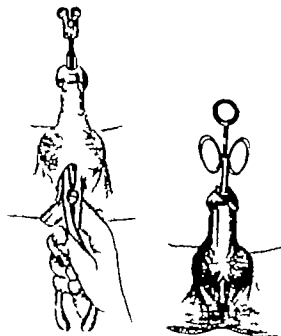


Fig 3 Making of a channel for the implantation of vein or appendix (Stettiner)

tirely one from the other or communicating. There are a number of varieties of this condition but the one just described is most common.

The most common variety next to this is one in which the external opening is at the junction of the penis and the scrotum. This opening sometimes is buried in a depression and at times so situated that it lies within a funnel formed by the scrotum while the really penile urethra is entirely missing (Fig 7).

The second variety is one which we would call the scrotal hypospadias (Fig 4). It is one in which the urethra opens in the raphe

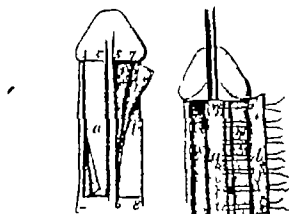


Fig 5 Anger's operation of hypospadias

of the scrotum. It is easily understood how this deformity develops when one considers the embryologic development. It is particularly in this class that we find the malformation aplasia penile of the corpora cavernosa, a minute penile extremity which resembles closely a clitoris.

The third and least common variety is the perineal variety in which there is absolutely no urethra present and the bladder opens with a short canal in the perineum. I have seen only one variety of this kind in all my practice and was unable to do anything for the patient. Before I could operate he disappeared from my observation.

#### PROGNOSIS

If left alone hypospadias remains without any change throughout life. A person is really not suffering except as we mentioned for the mental and physical disagreeable conditions and if one can put up with these he does not need any help at all. The treat-

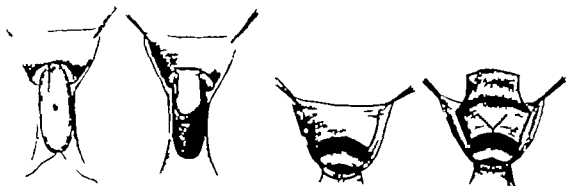


Fig 4 Ombredanne operation different stages in the formation of an anterior urethra

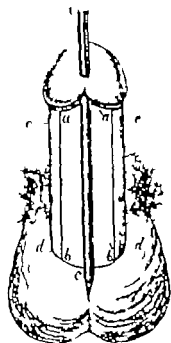


FIG. 6. Duplication of the clitoris.

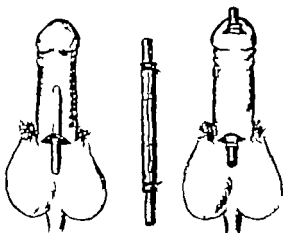


FIG. 8. The treatment of the clitoris. (ord. ng. t. Nov. Josseland)

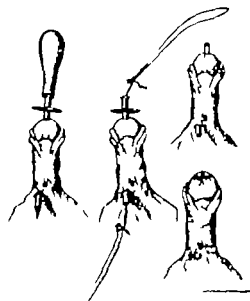


FIG. 9. Introduction of the needle and the different stages of operation.

ment however in the hands of an experienced surgeon gives an absolutely good prognosis. It is a well known fact that in medicine for those ailments which are the hardest to cure there are the largest number of remedies offered. It is also a sign of inefficiency and shortcoming of medication when we have a

great number of remedies and methods. The average surgeon has to choose from the chaos of methods to find the proper one for his case and without experience he often chooses the wrong method with subsequent failure unless he has had the good fortune to have been an assistant to a master when he is better equipped to select a method which will give him the best end results. The primary results after operations are often good enough but after a year or two the most promising primary results dwindle to insignificant advantages or even drawbacks. I have repeatedly been highly pleased with the result of my plastic. The flaps healed the urethral canal seemed perfect but when the patient returned in a few months the new urethra was a callous tortuous canal hardly penetrable by the probe with no urine passing through it because it passed more easily through a fistula or the old orifice.

Since this abnormality is not very common the average surgeon has not much experience with it hence most of the men experiment with these cases and have not much success. If a man who has been in surgical practice five or six years operates upon four or five cases of fibroid of the uterus in a year he certainly will not perform so good an opera-

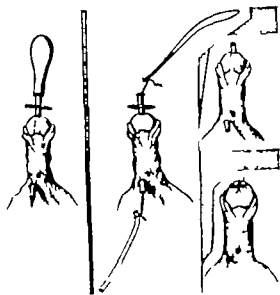


Fig 29 Introduction of the ureter after Schmieden

tion as a man who has been in practice the same length of time and has had occasion to operate upon 40 or 50 fibroids within a year

For similar reasons it would seem advisable to refer cases of hypospadias to the men who have had large experience in this particular line

#### AGE

There has been a wide divergence of opinion as to what is the best age at which to operate. Some authors have selected early childhood and even infancy but when the patient is so young the organs are so small and so delicate and it is so difficult to keep the wounds clean and free from contamination that the chances for primary union and a good plastic result are very poor. Plastic operation of this kind should not be done on infants. I do not operate as I said before upon patients less than four years of age but sometimes that is even too early. It depends a great deal on the condition and general health of the patient. However some parents are insistent that something should be done and there is one way of overcoming their anxiety. Since we operate in many instances in two or more stages we select for the first operation the early youth from four to six years for the finishing touches the age of eight to ten. We can thus do something at once to allay the worry of the parents

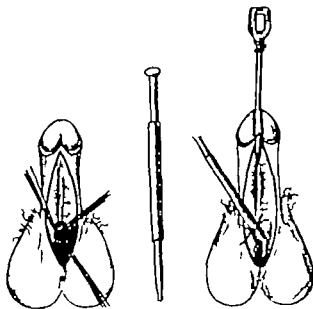


Fig 30 Another method of Nové Jossand

#### GENERAL CONSIDERATIONS BEFORE THE OPERATION

One has to study the case thoroughly before deciding upon a specific method and as I said before no ironclad rules can be made. There are however several important questions to be discussed which pertain generally to all cases of this class. The causes of failures are to be considered first.

The general health of the individual must be good and the patient must be worth

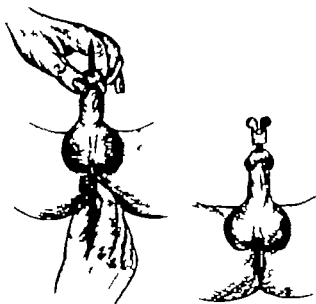


Fig 31 Perforation of a channel clear down to the scrotal opening

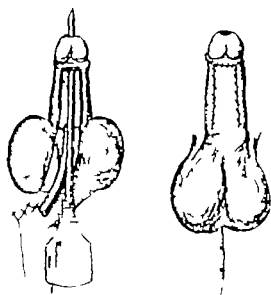


Fig. 3. Cantas method of em transplacation

the effort. If we have a puny delicate child with other deformities cryptorchism for instance and poor prospects that the child will ever be a healthy man we must not be too anxious to operate. The boy must be otherwise a promising subject. He should be in the best of health free from any other ailments such as adenoids, tonsil affections, kidney or bladder trouble etc. The urine must be normal and free from any pathological content. To operate upon a bad subject means failure.

The second cause of failure is infection of the wound even if an aseptic operation has been performed. The region is predisposed to infection the urine flowing over the wounds being almost invariably the cause of non union with ugly looking wounds which take a long time to heal. Therefore to overcome this drawback and danger it has been recommended that the flow of urine be sidetracked in the usual way by urethrotomy permanent catheter etc.

Thiersch recommended the penneal urethromy preceding this operation and H. Veillet has declared that it is immaterial which method is used if only the flow of urine is sidetracked by a penneal fistula. He thinks the cure may then be accomplished in

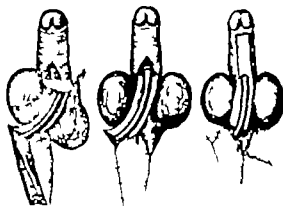


Fig. 33. Same showing the different stages of operation

one sitting. Some French surgeons (Tanton, Ruotte, etc.) have recommended the suprapubic cystostomy but others (Broca and Poncet) have restricted its performance to only those cases in which no penneal urethrotomy can be made. My own views in this respect have changed considerably with my experience. I also thought formerly that the use of the permanent catheter and the penneal section of the urethra were essential but my later experiences taught me that they are absolutely unnecessary and only complicate matters. All that is necessary is to leave the closure of the natural urethral orifice for the last step and use it as the urinary outlet until the whole urethral canal is finished. Good and exact suturing, as I will show in the detailed description of my technique permits the urine to pass over wounds and they will heal nevertheless. There is no more reason why a wound in the urethra should not heal if there is no leakage of urine between the stitches than that the bowel should not heal because the contents pass the wound in the latter. No leakage is the secret but if there is a leak a drop of urine or even the ordinary mucus or blood will prevent union (Figs. 9, 10 and 11).

This leads to the third cause responsible for failure namely inexact suture and inexact thin and shallow adaptation of wound surfaces. Broad wound surfaces closely adapted are the whole secret of primary union. No dead spaces must be left behind. The proper suture material is essential and here I may

say a word in praise of horsehair in the suture of plastic borders and particularly wounds of urethra and adjoining tissues

Intra urethral suture of catgut no matter how fine is bad. The catgut swells and loosens and favors leakage. The borders and stitch holes are infiltrated with urine and become easily infected, thus the suture is spoiled. Fine horsehair is the ideal material and it need not be removed from inside of the urethra; it drops out when it is not needed, often months after the operation.

Another not to be neglected factor in the success is the after treatment of these cases. They must be under personal supervision of the experienced surgeon himself and must not be left to an assistant or interne or even a nurse. The operation is often performed in an excellent way by the surgeon but the after cure is left in incompetent hands. Thus it fails and this is all the more regrettable because every failure makes a secondary operation more difficult.

Of late we use very simple dressings in our cases. We have found that in children and young people it is difficult to retain the dressings in the genital region and if general cleanliness is observed the patients fare better without any dressings whatsoever. In fact, we have found dressings of gauze and bandages very impractical.

#### WHEN DO WE REGARD A CASE AS CURED

I now regard a case as cured only when I have satisfied the following two conditions: (1) a perfect freely movable urethra permitting in erection without angular deflection of the penis during the same; (2) absolute absence of contracture or stricture of the urethra with free flow of the stream of urine after a lapse of years. The accomplishment of both of these conditions is the only criterion of success. It is not absolutely necessary to obtain a cosmetic result with smooth surfaces and a urethra in the center of the glans. This would be a cosmetic but not a clinical success. I have had to repair several cases in which such a beautiful anatomical or cosmetic result was obtained, cases in which from the start there was no indication for surgical operation. Because



Fig. 34. Transverse incision of ridge. The different stages of the author's latest method of treatment are shown in Figs. 34 to 41.

the urethral opening is not in the glans or not exactly in the normal position, is no indication for operation. The only indications for operation are the impossibility of straight erection and faulty urination. Many of the cases of mild hypospadias, therefore, ought not to be touched. It is easy to loosen the urethra and bring it out on the surface of the glans, but at the cost of shortening it and producing a lot of scar tissue which impedes and makes the act of erection even painful. I have therefore come to the conclusion that it is faulty to insert the newly formed urethra into the glans because it pulls the glans downward by the insertion. In my last and most successful cases I have placed it below and left abundant tissue around it to allow free stretching of it.

#### OPERATIVE TREATMENT METHODS

On giving the methods I will not mention all modifications and schemes but only those



Fig. 35 Freeing of the urethra



Fig. 36 Incision of the prepuce ready for transplantation



Fig. 37 Prepuce fixed on the frontal surface

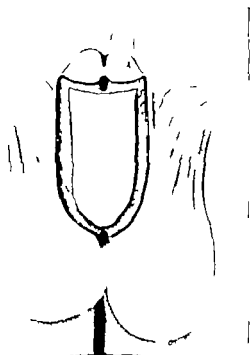


Fig. 38 Forming of an inner urethra by dissection

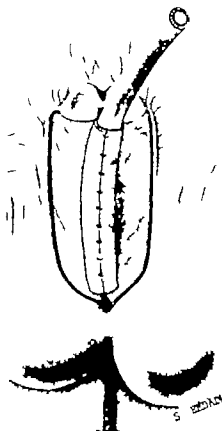


Fig 39 Inner urethra formed and surface ready for second flap

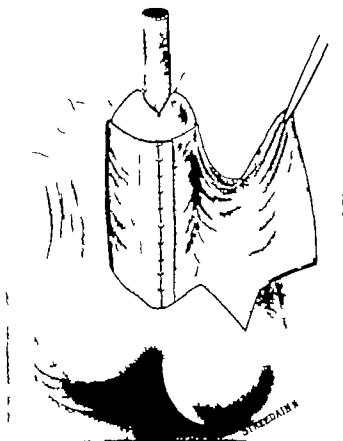


Fig 40 Dissection of the flap from the side ready for cover

which have some historical value or those which may be employed safely. Many of the procedures have been worked out theoretically only; some have been reported too early and in too few instances to be given any prominence or value. It may be best to describe the methods for the different classes although in principle the method may be identical for all stages.

First class of cases — penile hypospadias with well developed penis normal otherwise except that the orifice of the urethra is below the glans. There is hardly ever an indication for operation unless the mental condition of the patient is such that it is imperative. The patients may brood over the defect and then of course the operation should be performed.

1. Dupuytren method. The simple tunnelization, a trocar or a sharp straight knife cuts a tunnel into the glans and keeps it open by packing or sounding. From the border of the cut epithelialization takes place and in a few exceptional cases it seems to be successful. It was first practiced by

Dupuytren but Papadopoulos tells us that even before this author it was occasionally done.

In 1898 Professor Kuemmel presented two cases of glandular hypospadias in which he had good results with this plain method of tunnelizing. Of course these cases in which there is a blind sac lined with a fine mucosa within the glans and in which the tunnel consists simply in the union of these the epidermis will easily develop and the results which have been obtained may have been just such cases.

2. Dieffenbach's method consists in using the depression of the urethral orifice for the urethra and by freshening on of the glans or the two lips transforming it into a short canal. The fistula which remains between the short glandular tube and the old orifice is closed later on. One can obtain a good result in this way. Since all these cases have a well developed penis it is irrelevant what is done. There is no difficulty in erection and the orifice works well even if a fistula should remain.

3. Hamilton Russell suggests the use of the prepuce to line the tunneled glans and for this purpose he dissects a bandlike skin flap like a collar and pulls it through the tunnel wound with the epithelial surface inward. The drawing explains the method but the small bridge which he leaves is an illusory



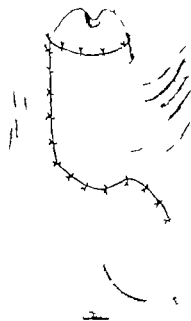


Fig. 1. The testis of a patient.

nutritious, and it is proposed to keep up the nutrition. At the same time the same method of the tunnel on the external orifice of the penile is used (Fig. 8).

4. The method of the external orifice is represented in the next degree by the operations of Van Hook and Ombrédanne. Van Hook forms a tube from the prepuce of the glans and pulls it out from the glans toward the orifice. The method is simple but very practical. It has the same result as all the former ones. Ombrédanne's first flap from the external orifice of the skin of the tube of the urethra in the shape of a tube. This flap is turned upward and forms the inner layer of the new urethra. The outer over is pushed by the prepuce. The prepuce is perforated and the large flap is gained by this perforation. Used to cover the first flap. This forms a good urethra. It is used both in the good results (Fig. 20 and 24).

5. The method of Lauenstein is a simpler method of a double flap. The urethra is formed by two flaps taken from the scrotum and covering each other (Fig. 9).

6. Duplay's method is similar. It may be used for the higher degrees of hypospadias (Figs. 26 and 28).

All these methods have lately been superseded by the Beck-Rochet method which

has found great favor with many surgeons. It is not a flap method but a dislocation or transposition of the urethra. If one considers that he can dissect the urethra for an inch or more and then pull it through a tunnel made in the glans, he has the whole plan of the Beck-Rochet method. While dissecting he can begin with a large collar around the external orifice. This collar will form a funnel when the dissection is finished and this funnel will increase somewhat the length of the prospective urethra. Thus it will be long enough to fit the length of the penis (Fig. 1).

Soubeyrand (1907) has called attention to this necessity; otherwise the urethra will be too short and produce a curve in the penis. Bardenheuer, Koenig, Jacob, and others have independently and about the same time suggested the same method and found it successful. The tube with its funnel is inserted and by sutures fastened to the newly made opening in the glans penis. One precaution is absolutely necessary when this operation is to be chosen, namely, to dissect the urethra far enough and not too close to the mucosa, so that it may not tough or become too rigidly infiltrated. If too much traction is necessary to bring the tube out through the tunnel, it will not heal by primary intention, particularly in case erection disturbs the healing. A large number of cases are cited in the literature about this method, but I think it is only useful in a limited number. Beck himself has extended its use for the penile variety.

Leguey is of the opinion that it ought to be used only for cases of three centimeters deficiency. I would say it is good only for the cases where through a cuff collarette it can be made longer and that is only when the orifice is in the region of the frenulum and the corpora cavernosa well developed. Wood reports a case of hypospadias operated on by Beck in which he had to loosen the scars afterward and the patient was glad to be in a condition as before the first operation. I have myself had to reoperate on cases in which such cicatricial condition produced an angular erection and all its discomforts and had to be reoperated on by my method.

Most of these methods suffer from one drawback which makes the result rather dubious the catarrical contraction. The flap methods are especially susceptible to this. One of the most peculiar things in plastic surgery is the fact that flaps shrink and are much smaller when they are healed in than when they are transplanted and this must be borne in mind by the surgeon. Most of us cut one flap too small at first and we are surprised how it dwindles down in size. A good sized urethra at the time of the operation will be a stiff rigid tube with thickened epithelium and a rigid wall hard to pass for probe especially when the flap contains very little elastic subcutaneous tissue. This is the reason I choose the elastic and still very thin prepucial for plastic altogether.

The second group comprises all the cases of penile and scrotal hypospadias. The operative methods to cure the penile varieties are partly the same as for the glandular only somewhat extended. The method of Duplay can be particularly used for these cases. It consists of the following steps

1. Loosening of the penis by the transverse incision and longitudinal suture (Figs 26 and 18)
2. Tunnelization of the glans and formation of two flaps from the side of the penis in such a way that one forms a tube representing the inner lining the other forms the cover of this tube externally (Figs 25 26 and 31)

I have tried this method several times but found however there is not enough material as a rule to make the tube wide and not enough flap for a cover. Several fistulae with small bridges are the usual outcome at the best, of this operation but there are reports of good success with the same (Figs 9 10 and 11).

The Beck Rochet method may be used but with result only in a curved penis. The following methods are better for these cases

1. Lauenstein bridge plastic. The four stages represented in the form (Fig 19)

First step is to dissect the penis from its base. This will bring about a large defect on the ventral side of the same. A lateral flap will form the inner urethra while the bridge supports the penis and brings it out from the defective position in which it is originally found. The Lauenstein plastic however is not practical nowadays. We have

simpler and better methods while the Thiersch method is still in use.

2. Landerer's method (Bidder also independently of Landerer has used the same method). A parallel incision is made to freshen on surfaces in order to heal the penis to the surface of the scrotum. The orifice lies then at the apex or glans whereupon the penis is dissected again from the scrotum leaving this time with the under surface of the new urethra, giving a rhomboid effect, which is healed by lateral adaptation leaving a well defined erectile penis. This operation I have tried once and I may say I would have succeeded if the healing had taken place as expected but it did not as suppurations took place and partial necrosis of the new urethra, so that I could not finish the case and had to use the Thiersch method, finally obtaining a very unsatisfactory result.

Besides all the scrotal plastics is the disagreeable complication of hair growing inside of the urethra which is very troublesome.

Frank of Vienna demonstrated four cases young men at the ages of 21 to 24 which he had cured with the Landerer Bidder method and which gave a good result except the erectility inasmuch as the tissues were slightly elastic and too scarry. Frank is fond of the method because in case of failure no tissues are lost.

3. The Rochet method is very popular especially in France. It consists in the formation of a tube from the part of the scrotum along the raphe and the pulling of this tube through a tunnel under the penile surface toward the glans. This is a good method which I have tried with moderate result several times. I found one difficulty which is not mentioned often. The orifice in the penile variety ends in a sort of funnel and when the tube is dissected this part of the urethra is very wide and the skin very thin and predisposed to a fistula which is hard to close. One of my cases still has a fistula as a result although I had twice sidetracked the urine by a urethrotomy (Fig 22).

4. Carl Beck's method is very similar to that of Rochet. The inner tube is made up from the penile under the surface while the outer covering is made up from the scrotum.

This operation of Carl Beck is used a great deal but it has a certain drawback. While we cannot make use of it except in cases where the penile extremity is well developed and has abundant skin on its lower surface to get enough material for a urethra we have to twist the outer flap when we cover the surface and we easily have gangrene right at this point and subsequently a fistula (Fig 22).

5. The foreskin (prepuce) as material for urethra is advocated by Koenig Kronacher and Van Hook. The latter formed a tube from the pre-

puce which he brought down through a tunnel in the prepuce in just the opposite way from that in the Beck-Rochet method.

Van Hook had only moderate success but Charles H. Mayo who used the method on several cases had good results from it.

Thevenard and Queenville have both used a similar method but there is nowhere great enthusiasm for this operation. I have employed it on several occasions and I must say that I have been disappointed. Its drawbacks lie in the fact that a large tube made from the prepuce becomes very thick and clumsy when pulled into the orifice as the base of the flap is there and it is hard to get a good union afterward even if it heals in it shrivels down to a mere line tract and it is hard to unite the penile urethra to the artificial canal. The fistula persists and other methods are to be supplemented to finish the case.

6. Ombredanne's method is very interesting particularly for me because through some of its features the suggestion of my present method came to me and I have every reason to be satisfied with its results. Ombredanne takes a flap for the formation of the inner urethra from a scrotal urethrostomy as in Figs. 30 and 31. He raises this flap and sutures it up to the orifice. He makes use of the prepuce to cover the raw surface in such a manner that he cuts a button hole in the prepuce and spreads the same over the raw surface. It is a double flap united on both sides of nutrition. The stages of the operation are well illustrated in the drawings (Figs. 30 and 31).

The results were good in the hands of Ombredanne. I have tried it but failed in one case because the space from orifice to gland was too long in that case to form a urethral inner flap without a pocket and a tendency to contract afterward. The outer flap saved it from entire failure but it was very difficult to close a fistula on the side and the urethra was very short, thick and scarry although most of the urine came from the new urethral orifice. Erection without curve was impossible.

7. Laurent had the ingenious idea in a case in which he failed with the Duplay and Thiersch method to make use of a flap on the side of the scrotum in the inguinal region in the shape of a bridge which healed and gave him a good result.

8. At this point I ought to insert my method for this class of cases. It is a flap method with the extensive use of the prepuce and gives a perfect result in almost every case. I have now observed fifteen cases for a period of from one to eight years or more. They have been almost normal in appearance and function but I shall reserve the description of the method and report of some cases for the future.

Many of the modern surgeons are inclined to give preference to other methods which consist in the use of the urethra and in the displacement of the same sacrificing one of the most necessary physiologic necessities, the possibility of erection.

The third group of operations of this class may be called displacement of the urethra to the glans. Independently of each other Beck of New York, Rochet and Bardenheuer (Brenner) in Germany have described this method which is commonly called the Beck-Rochet method. It consists in the following steps:

#### A. BECK-HACKER METHOD

1. Perform a prophylactic urethrotomy.  
2. Dissect out the urethra from its bed and pulling it forward through a tunnel made in the glans and returning the flaps into the wound in the glans preferentially of skin or a cuff which enlarges the urethra is included (Bardenheuer, Jacob Koenig, Soubeyran).

This method is really one of the most practical operations and has found a great many followers and enthusiasts (Figs. 21). In looking through the literature one finds more accounts of this procedure than of other operations. There are several conditions which are absolutely necessary for success.

There must be a sufficiently long urethra present. I most of my cases of true hypospadias such as not the case. Only those harmless abnormal openings below the glans in most of which I do not perform any operation is this the case and then the urethra may safely and easily be brought forward to a terminal glandular opening.

There must be an absolutely free erectility possible after the operation. If the terminal urethra shortens the corpora cavernosa a broken or arched penis during erection will be the most disagreeable consequence of an operation. Not only will the erectility be lacking but it will be very painful and the patient will demand relief. I had to reoperate on a number of cases of my friends for this reason.

3 There must be a body to the urethra, a thin membrane transplanted into the tunnel will shrink or even though a body of epithelium with sub-epithelial connective tissue must be present

If these conditions are fulfilled then the result may be beautiful. I have a number of such cases which have been well several years

B Transplantation of free flaps and organic structures Transplanting a free flap from the skin of the femur which was formed into a tube over a bougie and introduced into the tunnel in the penile skin was introduced first by Nove Jossierand in 1897. This epidermis tube healed in but the fistula could not be closed although other surgeons like Tuffier, Walter and Carlier imitated this procedure they could not obtain good results. Not only a fistula remained but such tubes could not remain patulous they shriveled and finally obliterated. In the years following this experiment a number of French surgeons and also Germans (Hoffmeister, Stuttgart) reported better results but it seems the method never was very much in favor. I have no personal experience with it. The detail of the method is easily read from the illustrations but the final results are far from satisfactory (Figs 23, 27, 28, 29, 30 and 31).

C Payr Leipzig who first made use of a free vein for the drainage of a hydrocephalus called forth the use of the vein for the urethral transplant by this experiment. Tanton (Val de Grace) and Unger (Vienna) made experiments on the dog to use veins for transplanting in the resected urethra and succeeded. Also Stettiner (Berlin) and Becker (Rostock) had positive results in the human. In both cases fistulae remained. Eiselsberg (Vienna) however could show a perfect result one year after such an operation and Muehsam had a perfect result in a case that was far from favorable because it concerned a patient with a gonorrhoeal stricture which led to a partial resection of the urethra. The details of this operation which I have performed once but without result are easily recognized in the illustrations. Some of the surgeons call attention to the necessity of taking a long enough piece of a vein (Lexer) to an exact Carrel Stich vessel suture in joining the urethra and the vein but all these precautions will avail little if the operation is not performed in a particularly favorable case namely in a case where the penis skin is free and long enough to allow free transplantation with absolute hemostasis and careful after treatment. The vein will shrink like any other tissue without a submucosa and necessitate bougieing for a long time if a fistula can be avoided.

D An interesting modification of this method is one by Cantas who uses a vein from the neighborhood with a skin flap connects it with the penis by an exact stitch and afterward uses vein and skin flap from urethra and penile flap. He obtained a functionally perfect result (Figs 32 and 33).

In 1909 Professor Schmieden demonstrated a new method of urethroplasty by a free piece of ureter which he grained occasionally during the excision of a kidney and once from a fresh dead body. The method is easily recognized by the study of his illustrations. The ureter has the advantage of being an organ adapted to the urine. In one case of three he had a good result (Fig 29).

Last of all but not the least interesting transplant is the appendix. To Streissler of Graz belongs the distinction of having recommended this superfluous organ for the urethra. It requires a stripping of the appendix of its serosa however in order to obtain a result. Unfortunately Streissler could not obtain an ideal result on account of persistent fistulae. Fritz Koenig has recommended the open vein to splice in secure suture over a mucosa and Hoymeyer has used free fascia for securing healing of a defect.

My own experience with a large number of cases leads me to the following conclusions.

We have to study each case individually and prepare a plan of operation. It may have to be modified somewhat in the course of treatment, but in general should be adhered to as closely as possible. We inform our patient or his parents at first that it will require in all probability several operations so that disappointments may not result if the success is not the desired one and that he may be prepared if it is necessary to perform another operation unexpectedly. This will save the operator a great deal of trouble and the patient a great deal of disappointment. He must be prepared to undergo several operations. Only the first and largest one is usually done under general anesthesia. A good many of the operative corrections can be done with local anesthesia if we have to deal with adults or older children. Younger children behave very badly under local anesthesia. By no means should we do an operation on a patient and cause him pain because we will have difficulty in even dressing the patient if he is frightened or in any way made hypersensitive. We should lay out our plans so that the largest piece of work is done at the first sitting and that the subsequent operations will be as far as possible only corrective measures.

I shall describe the three degrees of hypospadias with indications and operations which I use in my practice.

1 The case of a first degree of hypospadias. The urethra is not shortened by any malde-

velopment or scar formation. The opening of the urethra is on the ventral surface of the glans and very small. There is a trace of a channel or a blind dimple indicating where the urethra should have passed into the center of the glans. These cases very seldom require operative treatment but sometimes the patients have difficulties so they ask for a cure. The best method in this case is to form a cuff around the urethra opening and pull this new cuff through a channel made through the center of the glans (Hacker and Beck). This channel ought to be as long as possible and wide and thick inasmuch as the wound healing will take much better when there is a good deal of transplanted membrane than a thin tissue paper like piece which easily becomes gangrenous. The incision around the urethra is carried to about a quarter of an inch in a circle and the skin dissected loose to the urethral opening and the urethra itself dissected downward slightly so that we have a shape of a nail in which the newly made cuff forms the flanges of the head. Then we pull this cuff through the opening made in the center of the glans and suture the borders of the cuff to the glans with five or six individual horsehair sutures. This whole procedure may be done with hardly any loss of blood by an elastic constriction of the penis. The place where the urethra was and where the cuff has been excised has to be covered and the best cover for this place is not to sew it from side to side as is often done but to bring over the flap from the prepuce which is usually large in these cases and quite exuberant. This is done in such a way that the prepuce is raised and transfixed with a scalpel. The incision is enlarged laterally enough that the glans be pulled through this opening. The flap which forms and which has on two sides its connection with the prepuce is sutured on the two ends with a few points and adheres beautifully as a rule to the defect formed by the excision of the flange. This method is somewhat similar to the method of Ombredanne although not entirely the same.

The result of this operation formerly was not as good as it has been of late. I used to suture the defect on the ventral surface of the penis

from side to side and in that way even broadly united it does not adhere but separates and forms afterward a fistula. Shortly afterward when the urine begins to flow through this fistula the condition becomes the same as before the operation and the little channel which has remained from the transplanted cuff is gradually shriveled up and dwindles down to nothing. It is only when the urethra is kept open by the flow of urine that we can say we have a normal condition. Since I use the prepuce as a cover our results have been uniformly good.

2. The second degree is the hypospadias in which the urethral opening is much shortened. There is hardly any urethra between the scrotum and the external orifice. When we take the urethra end between our two fingers and pull it up so as to show to us the extent of the urethra we find as shown in Figs. 4 and 5 that the urethra is very much shortened; that there is an aplasia of the same and that whatever is there of the urethra is connected through a somewhat loose connective tissue with the corpora cavernosa. It forms a short tract of which the corpora cavernosa form the bow of an arch. These cases are the most commonly treated by surgeons. In the state of erection there is a shortening of the urethra and this is a very common complaint of the patients. These cases require real plastics of the urethra. Unless we make a new urethra we cannot achieve any success in any operation. Should we try in this case to transplant the opening which is on the ventral surface of the glans into the end of the glans we would make matters worse. By trying to make a cuff even ever so long we would not succeed. The urethra must be lengthened at least an inch to secure a good result.

#### TECHNIQUE

We begin by separating the orifice of the urethra from the glans and place it where it actually belongs. We take the glans between our two fingers and make transversely immediately above the orifice while pulling the glans upward. The borders of the transverse incision separate and form a rhomboid defect (Fig. 34). This rhombus will grad-

usually become larger and larger until it finally measures about an inch and a half or two inches in length and the opening of the urethra will be situated then at the root of the penis.

We have now to cover the defect which has the shape of the rhombus with a flap which can afterward be used also to the formation of the new urethra. For this purpose we employ best the prepuce again in the same shape as we have used it before in the operation of hypospadias of first degree but this time to cover the defect of the corpora cavernosa. Such a prepuce if spread out makes very good material for this purpose and the picture (Figs 35 and 36) shows how beautifully this can be accomplished and how nicely it heals. We are then in the position to form a new urethra about an inch and a half long a tube wide enough to act as urethra. In the first operation we do not need to make a by pass of urine we can fasten the corpora cavernosa with adhesive plaster over the pubis and in that way prevent soaking of these wounds with urine. Should we have to deal with a sensitive or very unruly patient or a child it might be good for two or three days to use a catheter (*à demeure*). We leave the prepuce flap in connection with the surface of the corpora cavernosa long enough to produce a good solid union which takes as a rule three or four weeks. After this has become established we begin with the formation of a tube by simply making on both sides a long incision uniting over a large sized rubber catheter the two borders of the wound and separating the skin to both sides far enough to get a good union of the outer surface of the skin (Figs 37 38 39).

As suture material I used catgut formerly but found that the finest gut was not as good as horsehair interrupted stitches tied into the urethral tube and cut very short answer best and give the best union.

At this time we use the natural urethra without a catheter leaving a fistula at that point where our newly formed urethra starts namely at the root of the scrotum. Wound healing is always very satisfactory and to our surprise, we have noticed that after wound healing has taken place notwithstanding the presence of the fistula at the root of the

scrotum, the urine to a great extent, passes through the newly formed urethra. We are then in the same position we would be in if we had to deal with a result of an external urethrotomy. Our difficulty is easily overcome by simply freshening the borders of the fistula and letting it heal out. Sometimes the individual steps of operations are not very successful. It takes two or three attempts but ultimately we have a good union and substantial urethra about two inches in length and wide enough as the pictures will show. The patient urinates in a full stream through the newly formed urethra and in a case of erection there is absolutely no scar formation or pulling (Figs 34 to 41 and Figs 12 to 16).

The third degree of hypospadias is one in which the urethra is situated at the junction of the penis and the scrotum or perhaps even within the raphe in a depression of the scrotum. In this case the penis is very much below normal growth. The testicles are usually very small and the whole genital tract appears more like that of the female, so that the distinction up to the age of puberty between a boy and a girl is very difficult.

One of our cases (Fig 1 for instance) Mr F who is now a university graduate about to be a professor in a school has been attending a girls college up to his nineteenth year as a girl and another case of the same kind is known to me personally and from other authors I know that these cases are not infrequent. I have seen cases reversed. For instance a very typical case of hermaphroditism with the following history.

A woman who came to see me about four years ago on account of an injury to her head which she had received by being hit with a champagne bottle in a brawl in a western gold field where she was overseer of some of her gold mine enterprises. She was a man woman. One of the peculiarities was that she acted in the capacity of a man overseer that she rode horseback almost all day took charge of a lot of men of some of the toughest character and was capable of controlling them. She explained that she has had male instincts and habits ever since she was a child and that she was dressed in boys clothes from the time she could remember until about her sixteenth year and always was taken for a boy until about that time when she began to menstruate.

The treatment of these cases of hypospadias will be based entirely upon the idea of enlarging the corpora cavernosa to such an extent that a urethra can be formed. Of course if the penis is as small as a clitoris an operation will be absolutely useless. If however the glans and corpora cavernosa are developed a urethra may be formed. In these cases the prepuce is unusually large and enough material present to produce a large urethra. The plan of procedure will be similar to that used in the second variety. It will be necessary first to produce a wound surface of the corpora cavernosa and bring the glans through a slit in the prepuce and outward so that the prepuce may be used as a cover of the defect or wounded surface of the corpora cavernosa. That is the first step. The penile extremity can be stretched and sewed on to the upper surface of the scrotum so as to allow a good healing of the flap of the prepuce on the wounded surface. This remains in contact for about two weeks or more whereupon there is abundant material from which to make a urethra. It is not a good plan to be saving with this material and to make a urethra of the caliber of less than a small finger because the tissue shrivels up and contracts afterward to such

an extent that if one does not take precaution the newly formed urethra is nothing but a hard scar like short channel which cannot be used for any physiological purpose.

The result of these operations on the whole are not very satisfactory although if performed in a young child between nine and twelve years of age a great deal can be done to develop the structures. On adults this kind of hypospadias gives very poor results. If the erectile tissues are not present or developed the urethra functionally is useless. I have had only one case out of probably six which goes back as far as twenty years ago in which I have had a good result in a variety of this last kind. I examined the patient a few years ago. He has been married for a number of years and has a family. The tissue have traveled considerably but erectile tissue has developed to a certain degree.

The penile variety of the hypospadias is a very important one although the result in this case not often is a good one because all the other tissues are atrophied or undeveloped. The method in these cases have to be selected according to each individual case. No general rules can be laid down. I have had no personal experience in treating this variety of hypospadias.

## PERNICIOUS ANÆMIA, WITH SPECIAL REFERENCE TO ITS SURGICAL MANAGEMENT<sup>1</sup>

By NELSON MORTIMER PERCY M.D. F.A.C.S. CHICAGO

**P**ERNICIOUS anæmia is a disease of unknown etiology in which the blood volume as well as the blood elements is progressively and certainly reduced until the blood becomes inadequate to carry on its vital functions of gaseous interchange, transportation of foods and waste products etc. when death ensues. Death may result earlier from fatty degeneration of the heart muscles or from changes and functional disorders of the nervous system. The majority of cases terminate fatally within three years while others may take a rapid vicious course and live only a few months. Three cases have been reported covering a period of fifteen years with long periods of remissions and relapses. Richard Cabot (1) states that of 1200 closely observed and competently diagnosed cases only 3 have ever been free from symptoms for six years. These he considers cured. Thus the mortality of the disease may be noted as 99¾ per cent.

Even at this time there are difficulties in establishing a rational plan of classification of anæmias because of our very meagre knowledge of the hæmatopoietic organs. Pernicious anæmia is an artificial and arbitrary term meaning the final degree of viciousness in anæmias. Vogel (2) has pointed out that the old classification of primary and secondary anæmias should be abandoned for logically considered there can be no such thing as a primary anæmia since the blood itself is not an organ but is the product of the various hæmatopoietic organs and in a way may be considered as a secretion and not as an organ. Vogel suggests that a reasonable classification would be to divide the anæmias into two broad classes one of which embraces those types in which the most conspicuous feature is a reduction in the production of blood elements while in the other group the principal feature is their abnormal destruction.

The fact that in pernicious anæmia there is usually found a hyperplasia of the bone marrow and in the blood many embryonal red cells would indicate that the blood producing organs are producing red cells at an increased rate. This increased production does not compensate for the destruction that is going on therefore there must be a hyperactivity in some way of the blood destroying organs. The various blast cells present in the blood represent the reserve currency of the bone marrow and indicate that the demand for erythrocytes is so imperative that the marrow being robbed of its finished cells throws off the parent form the erythroblasts. The degree of embarrassment of the marrow is probably indicated by the type of blast found in the circulating blood the more primitive the nucleated cell the greater the embarrassment of the marrow. In some late severe cases no nucleated cells may be seen whatever indicating that the marrow the constructive agent has become exhausted and conquered by the destructive agent, whatever that may be.

From this it would seem that pernicious anæmia should be classed as a hæmolytic anæmia that is among those in whom there is a marked increase in blood destruction making a pathologically increased demand upon the blood producing organs. But as Vogel (2) has suggested there must be in pernicious anæmia more than a mere hæmolytic agency because of the fact that in hæmolytic icterus there are evidences of an increased hæmolysis yet the anæmia seldom assumes a grave character. He believes that in pernicious anæmia the myeloid tissue also is deeply implicated by the hæmolytic factor and finally becomes bankrupt under the double strain of supplying the abnormal demands on its hæmatopoietic function and in resisting the direct onslaught of the myelotoxic substance.

<sup>1</sup>Mortimer lectures delivered before the college of Physicians and Surgeons Philadelphia December 5 1916



operated upon 37 cases of pernicious anemia. This report however will include only the first 24 cases in which the elapsed interval since the operation has been six months or more because the majority of the others have been operated upon too recently for their report to be of value.

The regions in which foci were found were the gall bladder the appendix and the mouth and throat. In 20 of the 24 cases chronic cholecystitis with or without stones was present 17 of which also presented evidence of previous inflammation of the appendix and 6 of this group also had marked infection in or about the teeth and 1 had infected tonsils. Four cases had marked evidence of a subacute infection in the appendix. In 1 case the only focus found was in the teeth.

A bacteriological examination was not made in these cases the diagnosis being determined from the clinical and macroscopic pathological conditions found. Recently a bacteriological study of the various specimens removed at the time of operation has been attempted with the result that in every case except one micro organisms have been grown from one or more of the organs removed. From the last 9 cases of pernicious anemia operated upon all of the specimens removed were sent to the Laboratory of Clinical Research of the Sprague Memorial Institute for bacteriological study. The report on the specimens follows.

**CASE 1.** Specimens examined—spleen gall bladder and appendix. The hemolytic streptococcus and streptococcus viridans were grown from the appendix. No growth from spleen or gall bladder.

**CASE 2.** Specimens examined—spleen gall bladder and appendix. The hemolytic streptococcus and colon bacillus were grown from the spleen. The hemolytic streptococcus and streptococcus viridans from the appendix. No growth from gall bladder.

**CASE 3.** Specimens examined—spleen and gall bladder. Appendix had been previously removed. The colon bacillus was grown from the gall bladder. No growth from spleen.

**CASE 4.** Specimen examined—spleen. The appendix had been previously removed and the gall bladder was pronounced negative at time of operation. No growth obtained from spleen.

**CASE 5.** Specimen examined—spleen gall bladder and appendix. Hemolytic streptococcus was grown from spleen. The hemolytic streptococcus and streptococcus viridans from the appendix. No growth from gall bladder.

**CASE 6.** Specimen examined—spleen gall bladder and appendix. The colon bacillus was grown from the gall bladder. The hemolytic streptococcus from the appendix. No growth from spleen.

**CASE 7.** Specimen examined—spleen gall bladder and appendix. The staphylococcus albus was grown from the spleen. The colon bacillus and hemolytic streptococcus from the gall bladder. No growth from appendix.

**CASE 8.** Specimen examined—spleen gall bladder and appendix. No growth from spleen. Hemolytic streptococcus was grown from appendix. Hemolytic streptococcus and colon bacillus from gall bladder.

**CASE 9.** Specimens examined—spleen gall bladder and appendix. Spleen and gall bladder were negative. The hemolytic streptococcus and streptococcus viridans were grown from the appendix.

In this connection it may be interesting to mention that in a recent case of Banti's disease in which the spleen and appendix were removed the hemolytic streptococcus was grown from the spleen and the hemolytic streptococcus and streptococcus viridans from the appendix. In the 9 cases of pernicious anemia bacteria were grown from 3 of the 9 spleens removed from 4 of the 7 gall bladders removed and from 6 of the 7 appendices removed. The only case not giving a bacteriological growth was the one in which the spleen was the only specimen removed the appendix having been previously removed. This patient had had a long standing pyorrhea for the relief of which a number of teeth had been extracted. No culture was made from the mouth.

The predominating micro organism found was the hemolytic streptococcus being obtained in 7 of the 9 cases the colon bacillus in 5 the streptococcus viridans in 4 the staphylococcus albus in 1.

While it is impossible at the present time to state anything definite concerning the relation of these various infections to pernicious anemia it is certainly an interesting observation from the standpoint of both etiology and treatment.

In view of the fact that pernicious anemia

is in all probability a disease of infectious origin and that the spleen has an abnormal hæmolytic action on the blood elements with a late bone marrow exhaustion we have been more and more firmly convinced that the rational treatment consists in three main factors viz (a) massive step ladder transfusions of whole blood (b) splenectomy and (c) removal of all possible sources of infection.

Each of these steps plays an important part in the treatment. The repeated blood transfusions nourish and stimulate the bone marrow to action and help to restore the secondary changes in the various organs the splenectomy unquestionably reduces the amount of blood destruction and the removal of the various foci of infection relieves the patient of a chronic toxæmia and possibly of an etiologic factor of the disease.

While the diagnosis of pernicious anemia usually is not difficult a careful study should be made to discover if possible the existence of some factor which may produce a clinical picture resembling that of pernicious anemia before treatment is instituted.

The most common condition in which mistakes are apt to occur are carcinoma of the intestinal tract, syphilis and intestinal parasites especially the entamœbre histolytica. If in every case a Wassermann test is made if the stools are carefully examined for intestinal parasites if a complete gastro intestinal examination including a roentgen ray examination is carried out, and if a thorough microscopic examination of the blood is made, a correct diagnosis will usually follow.

#### INDICATIONS FOR OPERATION

In analyzing the various patients that have been splenectomized it is evident that certain cases are unsuitable for operation. The degree of anemia present is of less importance in determining whether or not operation should be done than are the clinical manifestations of the disease. Patients showing nervous or mental symptoms or evidence of pathological changes in the spinal cord, probably should not be considered as surgical. While in these cases the blood picture will often be improved for a considerable time it does not seem to in-

terrupt the degeneration that is taking place in the spinal cord and central nervous system. Splenectomy should not be attempted during an exacerbation of the disease, especially if this be accompanied by a severe diarrhoea which is often the case. In the majority of cases however by a series of blood transfusions the exacerbation can be rapidly changed so that in three to five weeks the case will be suitable for operation. Patients with temperature, recent hemorrhage or purpuric eruption should not be operated upon unless these symptoms disappear following a series of blood transfusions.

Operation should be considered in all other patients as soon as a positive diagnosis of pernicious anemia is made and as soon as all conditions which might be a factor in producing anemia which can independently be relieved have been excluded.

The transfusion of blood has recently received a great deal of attention and has been advocated by some as the sole means of treating pernicious anemia. Its employment will result in marked temporary improvement in the vast majority of cases. Our experience has been that, while the blood picture will improve immediately in practically every case and that in some early cases a very prompt and marked remission will take place and may persist for a period of several months on the other hand in the late cases the improvement in blood picture from transfusion alone is very transitory as the blood will begin to decline within a period of two to three weeks unless transfusion is repeated.

In all of our cases except 2 that have come to operation transfusion has been used as a preliminary measure. It has also been employed in several extreme cases simply as a means of prolonging life for a short time. Ottenberg and Liberman (16) found that in 24 cases of pernicious anemia treated by blood transfusion only 14 showed, for a time, progressive improvement. In 11 cases however transfusion was of no avail. From this they conclude that blood transfusion induces a remission in about one half of the patients and that if improvement does not follow the first transfusion another should be given from a new donor.

During the past three years the author has transfused 31 patients suffering from pernicious anemia including the 37 that have come to operation and a marked improvement both in the blood picture and clinical condition of the patient has resulted in all but 1 case. This patient was brought to the hospital in a comatose condition received one blood transfusion with practically no change in condition and death resulted eight days later.

The immediate effects of transfusion are usually quite striking. The red blood count is increased often doubling immediately if the count is very low, the hematocrit percentage rises and the number of platelets is increased. The blast cells usually become more numerous and occasionally Howell's particles will appear in the blood indicating a stimulation of the bone marrow.

Roberts (17) studied 4 cases of pernicious anemia treated by blood transfusions with a view of determining the effect of the treatment in the excessive output of urobilin. Three of the 4 patients gave evidence of a resulting bone marrow stimulation and at the same time showed temporary increase of urobilin excretion. In one instance there was no change in the output of urobilin.

After transfusion the patient immediately volunteers as a rule the information that they feel stimulated and much stronger than they felt before. A few hours later they become ravenously hungry while previously food had to be forced upon them. This hunger and relish of their food persists even after the red blood count begins to fall which usually takes place about two weeks or ten days later. With the improvement in the appetite the mental symptoms grow better the insomnia is relieved and the glossitis clears up. We are thoroughly convinced that the transfusion of large masses of whole blood accomplishes more than the mere mechanical addition of so much blood. It seems that it actually exerts either a curbing influence upon the hyperactive spleen or a stimulating action upon the bone marrow since the blood picture continues to improve for several days after

transfusion. This may be due to the fact that the blood forming organs are not only overworked but are also undernourished. Furthermore the multiple blood transfusions supply protective antibodies and assist the patient in getting rid of the secondary changes which have taken place in the various organs. During the period that the patient is being prepared for operation by multiple blood transfusions the patient should be treated in regard to any self evident infection.

The patients begin to improve immediately after the first transfusion and continue to improve with each subsequent one until they are good surgical risks and splenectomy can be done without greater shock than would be produced in any other patient by an operation of the same magnitude.

#### METHOD OF TRANSFUSION

Since the transfusion of blood began to attract so much attention many methods for accomplishing this have been devised making transfusion practical. The method used in our clinic which was described in *SURGERY GYNECOLOGY AND OBSTETRICS* in September 1915 is briefly in indirect closed method.

The apparatus consists of a specially designed glass tube of 50 cubic centimeters capacity one end of which is drawn out to a small cannula which may be inserted directly to the vein. The other end of the tube is in a small tube to which a Y connection is made. To one arm of the Y rubber tube is attached to add in injecting the blood. In open dissection of the vein of both the donor and recipient is made. The tube is coated inside with solid grooved paraffin and just before the tube is inserted into the donor's vein about 5 cubic centimeters of sterile liquid paraffin is aspirated into the tube. As the tube fills the liquid paraffin will float on top thus preventing the blood from coming in contact with the air. The cannula of the tube is inserted distally into the donor's vein and the tube is allowed to fill. The flow of blood is accelerated by the use of a ordinary blood pressure cuff proximally placed and pumped up to 5 or 6 millimeters of mercury less than diastolic pressure. This impedes the venous return but does not interfere with the arterial flow thus making the arterial a blood reservoir and increasing the pressure in the vein selected. Slight suction facilitates filling the tube. Six hundred cubic centimeters can easily be obtained in three minutes when the tube is transferred to a vein of

the recipient (usually the cephalic) and the blood is forced into the patient by means of an atomizer bulb and rubber connections. The tube can be emptied in about a minute and a half, but greater deliberation is advisable so that possible hæmolytic phenomena may be noticed, acute dilatation of the heart avoided, and so that aeration of this venous blood may be more ready. Inhalation of oxygen in very weak patients is advisable during the injection of large amounts of venous blood. The average amount of blood given each time is from 500 to 700 cubic centimeters, and you will note that the plain whole blood is used, not being diluted with any foreign substance.

**Blood tests** The most important part of transfusion is the selection of a healthy donor by means of hæmolytic and agglutination tests between the two bloods. During the past year the author has been determining the hæmolytic action of the blood by the Moss (18) method the technique of which has been modified by Brem (19). This method is based on the principle that before the serum of one blood will cause an hæmolysis of the corpuscles of another it will first, or simultaneously cause an agglutination of the corpuscles. The reverse that all cases that show agglutination will also show hæmolysis is not necessarily true. Adopting this principle all bloods are classified according to the agglutinative properties of their elements into one of four groups. In selecting a donor it is always advisable to have a donor whose blood belongs to the same group as that of the patient. If this is impossible the donor's blood should belong to a group whose corpuscles are not agglutinated by the serum of the patient.

Group I 10 per cent Serum does not agglutinate corpuscles of any group. Corpuscles are agglutinated by serum of II, III and IV.

Group II 40 per cent Serum agglutinates corpuscles of groups I and III not IV. Corpuscles are agglutinated by serum of III and IV not I.

Group III 7 per cent Serum agglutinates corpuscles of groups I and II not IV. Corpuscles are agglutinated by serum of II and IV not I.

Group IV 43 per cent Serum agglutinates corpuscles of groups I, II and III. Corpuscles are not agglutinated by any serum.

The serum of one group will not agglutinate the corpuscles of blood belonging to the same group.

In grouping the blood the unknown blood should be tested with a blood whose group is known. This standard blood must be long to either Group II or III in order to be of value in grouping other blood. The technique for the grouping of blood according to Moss's classification as modified by Brem is very clearly described in the *Journal of the American Medical Association* July 15 1916.

The determination of the hæmolytic reactions of blood by the Moss method in the selection of donors has proved very satisfactory in our hands. Since adopting this method 91 transfusions have been made without encountering a single case of hæmolysis. The milder reactions have been rare. These have been manifested by a chill in 5 per cent of the cases and by temperature occurring on the same or following day in 10 per cent of cases.

#### TECHNIQUE OF OPERATION

**Incision** We elect the high midline incision instead of the usual left rectus for the reasons that first other pathological conditions such as the gall bladder appendix gastric ulcer etc. may be dealt with second this incision can extend higher than any other namely to the ensiform cartilage third the pedicle and blood supply of the spleen are readily accessible since their course is from the midline toward the left, thus enabling one to reach them under the spleen's edge without having to pull the spleen outside of the abdomen. The pedicle of the spleen in pernicious anemia is usually short, and there is less danger of tearing its veins if it is pulled toward the midline as it is dislocated and lifted from its bed.

Having opened the abdomen through an ample incision a thorough exploration of the abdominal organs should be made noting the condition of the appendix gall bladder and bile passages. Any pathological conditions found in these regions should be dealt with as in any other patient.

**Splenectomy** A large abdominal pad is placed in the left upper quadrant of the

abdomen keeping the colon and small intestine from the field of operation. The dislocation of the spleen from its location against the diaphragm and left kidney is easily accomplished by gently passing the fingers between the spleen and these structures keeping the fingers in close contact with the spleen surface during the manipulation. As the spleen is dislocated it is gently rolled toward the midline and a hot moist pack is placed in the space from which the spleen has been lifted to control any bleeding until the rest of the operation is completed. The hemorrhage from the adhesions even though considerable in some cases is easily controlled in this manner. In mobilizing the spleen the tail of the pancreas should be kept in mind as it is occasionally adherent to the under surface of the spleen and also to its pedicle along its posterior surface. After the spleen has been elevated the gastro-splenic omentum is caught between forceps and ligated. At the lower pole of the spleen this is very simple at the upper pole where it contains the *vasa brevia* several in number as they run from the splenic artery to the greater curvature of the stomach it is much more difficult. The edge of the spleen is frequently in close apposition with the fundus of the stomach in this region. As soon as the *vasa brevia* have been ligated the fundus of the stomach can be depressed and the pedicle of the spleen readily caught with two pairs of forceps the blades of which are covered with rubber tubing. The pedicle is now transected with heavy catgut and ligated *en masse*. The gauze pack is now removed from the space where the spleen was located and if any bleeding persists from the small vessels torn while separating the adhesions they are stitched with fine catgut. The abdomen is closed without drainage. Immediately after the close of the operation a transfusion of 600 to 1000 cubic centimeters of blood is given.

Of the 24 cases here reported splenectomy, cholecystectomy and appendectomy were done in 17 cases, splenectomy, cholecystectomy and appendectomy in 1 case, splenectomy and cholecystectomy in 2 cases, splenectomy and appendectomy in 3 cases.

splenectomy alone in 1 case. In this one several teeth were extracted later as well as the tonsils removed in one other case. Teeth were also extracted in 5 other cases. Transfusion was done routinely on the table immediately at the close of each operation. There were two operative deaths.

The average number of transfusions given each patient was 3.5. The average amount of blood given was 2340 cubic centimeters.

The average length of time from first transfusion until splenectomy was 6 days, average time in hospital after operation 27 days.

The average age of the patient at time of the operation was 47 years.

The average duration of symptoms of disease on admission to hospital was 17 months.

#### IMMEDIATE EFFECTS OF SPLENECTOMY

Immediately after a splenectomy a leucocytosis occurs varying from 10,000 to 30,000. In a series of 6 cases in which a blood count was made just after section of the pedicle the white count was found to range from 10,000 to 12,000 within five to ten minutes after splenectomy, this being a lymphocytic leucocytosis. In these 6 cases just before operation the average leucocyte count was 4,000, the lymphocytes averaging 35 per cent while within 10 minutes after the spleen pedicle was tied the average lymphocytic count was 67 per cent. This lymphocytosis gave way to a polymorphonuclear leucocytosis within twenty-four hours which persisted for a number of days. In all of our cases the white count has persistently maintained a much higher level than it did before operation. The primary lymphocytosis is probably due to the manipulation of the spleen before its pedicle is tied. In most cases there was a marked increase in the number of blast cells beginning within two or three days after operation. In 3 of the 24 cases Howell-Jolly bodies were noted primarily before any treatment, after one or more transfusions they were noted in 10 cases and after splenectomy they were present in all appearing within a day or two after operation.

A low platelet count was a rather constant finding primarily. Some increase in platelets

was noted constantly following the transfusion and a marked increase following splenectomy. Lee Minot and Vincent, in discussing the increase of platelets following splenectomy report a postoperative thrombosis in 3 of 15 cases and suggest that there may be some association between the increase of the platelets and thrombosis in these patients. Fortunately we have not met with thrombosis in any of our cases.

After a slight fall following the operation the red blood count and hemoglobin steadily rise the gastric condition improves and there is a decided gain in weight and strength the red cells tend to lose their misshapen condition and become more uniform in size the color index falls to approximately one, and the normal ratio between polymorphonuclears and small lymphocytes is gradually established after the initial polymorphonuclear leucocytosis declines. The gain in the clinical symptoms is often out of proportion to the improvement in the blood picture.

## RESULTS

	On Admission	On Discharge
The average red blood cell count	1 310 000	3 700 000
The average white blood cell count	4 037	10 330
The average hemoglobin	36 per cent	70 per cent
The average color index	1.4	0.9
The average coagulation time	7 minutes	5 minutes
The average blast cells were 4 per cent (of 100 W B C)		rate

Of the 24 cases here reported there were two operative deaths 8.3 per cent. One of these died on the twelfth day from uremia the other about sixteen hours after operation apparently from some form of blood crisis beginning about five hours after operation. One patient showed practically no improvement but had relief from mental and gastric symptoms for four weeks, at the end of which time the symptoms recurred the spinal cord symptoms progressed rapidly and patient died at the end of ten weeks. The other 21 or 87 per cent, were markedly improved. Two patients had recurrence of symptoms at the end of four months death at eight months. One died from an accident four months after operation with blood count nearly five million. Four cases had recurrence of symptoms just about six months after operation interval of these now since operation eight, nine

ten and eleven months respectively. The other 14 or 58 per cent are all clinically in good condition the interval since operation being as follows 3 about seven months 2 eight months 2 nine months 1 ten months 1 fourteen months, 2 fifteen months, 1 eighteen months 1 twenty three months and 1 thirty two months. This latter case at the end of two years and eight months is clinically perfectly well and carries no evidence of pernicious anemia in her blood except that an occasional normoblast can be found. In every case except one in which recurrence of the disease has occurred the patient presented mental nervous or spinal cord symptoms at the time they came under treatment and in most of them these symptoms occurred early in the disease.

From our observations of these cases it would seem that in all cases of pernicious anemia with involvement of the spinal cord and central nervous system the prognosis is extremely bad under any form of treatment, and the patients should not be operated on. It is possible that, if the cases with involvement of the central nervous system could come to operation early they might avoid nerve degeneration and have a better prognosis.

## THE MORBID ANATOMY OF 23 OF 24 SPLEENS REMOVED

It is a significant fact that with all the studies that have been made of the spleen in pernicious anemia, there has been no constant, definite pathology observed and accepted by a majority of the numerous workers in this field. In fact, the true process in the spleen does not appear to be cellular but rather that of an abnormal physiological or chemical activity causing hemolysis of the red blood cells in the circulation. However there have been demonstrated certain findings in the fresh spleens removed during the active stage of the disease which are not obtained in those examined at autopsy. It is a well known fact that the spleen changes its structure very rapidly after death, so that a study of the organ in its fresh state immediately after removal is imperative in order to obtain a true conception of the morbid changes present.

The following is a report of the gross and microscopic changes found in 23 spleens of this series of cases.

*Size* Clinically the spleen of pernicious anemia has usually been reported as not palpable. Moffit (11) reports that Cabot records enlargement in 13 of 110 cases. Billings in 5 out of 40 and Hunter records autopsy findings of spleens weighing 370, 390, 330 and 300 grams respectively. In our series the weights are somewhat similar to those given by Krumbhaar (10) who collected information as to the size of 89 spleens removed at operation which was as follows: In 31 per cent the spleen was either small or approximately normal in size. In 40 per cent the spleen was slightly enlarged and in 23 per cent it was considerably enlarged. He also noted that better postoperative results were obtained in cases with enlarged spleens.

In our cases the largest spleen weighed 500 grams and the next largest 480 grams. These two were the only ones clinically palpable before operation. The smallest weighed 120 grams when in the fresh state and only 90 grams after fixation in Kauselin's solution. There were six or 26 per cent weighing between 120 and 200 grams. The other 17 or 74 per cent varied from 200 to 500 grams. The average weight of all the spleens was 80 grams or about 80 grams larger than normal. The average weight of spleens removed from patients in whom there was a recurrence of symptoms after operation was 30 grams; in other words these spleens were but slightly increased in size from normal. The average of the spleens of patients clinically in good condition at intervals since operation ranging from 32 months to 6 months was 306 grams. The spleen of one case clinically well during the past 9 months however weighed 180 grams and that of another well since 10 months weighed 190 grams.

It will be noted from these findings that the spleen of pernicious anemia is only slightly larger than the normal spleen. It is also a fact that with but few exceptions these patients having relatively large spleens offer a better prognosis than do those in whom the fresh spleen weighs less than 50 grams.

*Shape* All but one of the spleens had the typical shape of the normal. Where marked congestion was evident however they were more rounded and the edges were less sharp. Three notches were noted in one spleen and two notches in each of two others. One however was long and narrow and possessed almost the identical shape of a horseshoe.

*Position* They were all placed in the upper left abdomen and the normal relations to the surrounding organs obtained except when there were adhesions of the splenic flexure of the colon, the jejunum or of the stomach.

*Pedicle* In all cases the pedicle was short due to the dilatation in most instances of the splenic veins. Consequently the space from the spleen to the stomach was often so narrow as to cause difficulty in clamping the pedicle without injuring the stomach or pancreas.

*Adhesions* In all but two cases there were marked strong fibrous adhesions encountered which added somewhat to the difficulty in removing the organ. In fact this evidence of perisplenitis was one of the most characteristic findings that was present. Those most frequently found and also the strongest were between the capsule and diaphragm. The posterior half of the diaphragm was oftenest involved. Other organs adherent in this way were the splenic flexure of the colon, transverse colon, jejunum in one case, omentum, stomach, pancreas and abdominal wall. Twice the spleen was universally adherent to all of the surrounding tissues. In some cases these adhesions were so strong as to cause a marked hemorrhage when they were separated. The capsule was often visibly thickened at these points. In three cases bleeding areas on the diaphragm following separation of adhesions had to be stitched.

*Color* Three of the spleens were bluish purple in color, 5 were grayish blue, 1 was dark reddish purple and the remainder resembled a slightly congested normal spleen. Small white scars from 0.5 to 2 millimeters in diameter were noted in 2 cases. Fine pitting of the surface was frequently seen.

*Consistency* The spleens removed were as a rule rather tough and resistant to pressure. Some were definitely fibrous and two

could be pitted upon pressure. There was no lobulation noted.

*Cut surface.* There was marked fibrous resistance against cutting in 40 per cent of the specimens. Two of them, the same two that showed other evidences of passive congestion, were brittle and could easily be broken across. The cut surface in all instances was convex and the pulp was not easily expressed. In all cases there was a relatively large amount of purplish (some what) viscid blood obtained upon sectioning the fresh specimen. The color varied from bluish gray to dark purple, but a light bluish red predominated.

*Accessory spleens.* In two instances there were found at operation several small accessory spleens. In one case two were found in the omentum at the hilum and one in the gastrosplenic fold, each about 2 centimeters in diameter. In the other case two masses were found surrounding the splenic vein in the pedicle. In this case one of the accessory spleens was 3 centimeters in diameter and the other only 1 centimeter.

*Microscopic pathology.* Although it did not occur in every case, the most constant finding was fibrosis. There was fibrous thickening found in the capsule, trabeculae, blood vessels, and even in the pulp areas. Such changes were found in sections of 19 of the spleens removed. Although the smaller and larger arterioles were usually thickened with either fibrous hyaline tissue, the sinuses were, as a rule, comparatively thin walled and collapsed. Great masses of red blood cells in all stages of degeneration were found crowded into the pulp spaces.

Polymorphonuclear leucocytes were constantly present and evidences of phagocytosis of red cells repeatedly seen. There was a definite increase in the number and size of the macrophages in two of the preparations. It was not possible in most instances to determine an actual increase in number of the parenchymal cells, although they were crowded together more than in the normal. This fact may be due, however, to the presence of an abnormal number of red cells and their products. There was marked lymphocytic infiltration seen a few times beneath

the capsule, especially beneath the perisplenic adhesions. Abnormal collections of leucocytes or lymphocytes or other evidences of localized areas of infection were not observed.

Pigment was not a constant finding. We found practically none in 12 cases (50 per cent), a small amount of very finely granular precipitate in 4 cases (17 per cent), and in the remainder were seen rather large brownish black masses scattered in the follicles and pulp spaces.

#### SOURCES OF INFECTION

*Gall bladder.* There were evidences of cholecystitis found in 20 of the cases (84 per cent). Nineteen of the gall bladders were removed and 1 was drained. In 15 cases there were marked adhesions about the gall bladder to some or all of the surrounding organs. Seven contained gall stones, varying in size from a single large cholesterol mass 3 centimeters in diameter to large numbers of small bile pigment stones 1 to 2 millimeters in diameter. The bile was found to be thick and tarry in 3, sandy in 2, clear mucoid in 1, purulent in 1, and mucoserous in the remainder of the cases. The so-called strawberry appearance of the mucosa was present 8 times. In 10 enlarged lymph glands were noted about the cystic and common ducts.

*Appendix.* In 20 cases there were definite signs of previous or present inflammation in or about the appendix. All except 5 were of the chronic type with late results, such as obliteration of the lumen, submucous fibrosis, infiltration with lymphocytes, and fibrous adhesions between the appendix and the surrounding organs. Four were subacute cases with evidence of recent inflammation. One was a large, degenerated cystic appendix measuring 6 x 10 centimeters.

*Other sources of infection.* In several of the cases, there were found and eradicated several other sources of infection, namely, infected teeth, infected tonsils, pyorrhœa, alveolar intestinal stasis, etc.

In order to remove effectually all possible sources of infection, an excision of the gall bladder or appendix, or both, was done wherever evidence of such infection was present. It was deemed wise to remove the gall bladder wherever it was infected rather than to



drain it believing it to be a quicker and surer method of relieving the patient of this source of infection. We have noted no evil effects from the latter procedure.

#### SUMMARY OF THE MORBID CHANGES FOUND IN PERNICIOUS ANEMIA

We do not know why a given case of pernicious anemia will fare better without than with the spleen. Up to the present date no constant and typical pathology in the spleen has been observed. The changes found are such as could have been caused by an infective process, the effects of which are evidenced by fibrosis throughout and a moderate increase of lymphocytes. Inagocytosis of degenerated red cells is much more pronounced. The pulp areas are at times greatly crowded and distended by red cells in various stages of degeneration. It would seem then that there is some process going on in the spleen which causes an increased destruction of red blood cells. From recent studies made it seems possible that the streptococcus with hemolytic properties may prove to be the organism primarily responsible for the process. If such an organism were isolated and then injected into the spleens of experimental animals it might be possible to produce a condition of pernicious anemia in them.

While there can be very little doubt as to the theory of pernicious anemia being a hemolytic disease it is not certain as to where or in what manner the hyperhemolysis takes place. Further clinical and experimental research should be made with the hope of determining the true nature and source of the hemolytic agent at work.

It has been suggested that the factor responsible for the increased hemolysis is not due so much to a pathological condition of the spleen as to the formation of some toxin the result of an infection which sensitizes the blood cells making them more susceptible to the action of the spleen. Again it has been suggested that the blood corpuscles are sensitized in some way by the spleen and are later destroyed in the liver lymph glands and bone marrow. Nevertheless the fact remains that a splenectomy

even in some of the late cases of pernicious anemia has been followed by cessation of the hyperhemolysis indicating that the spleen is at least an important link in the chain necessary for the production of the disease.

While no surgeon can say that a cure has resulted from splenectomy or other surgical procedures in any case of pernicious anemia still there is enough clinical evidence to show that the benefits derived from surgery are more than by any other means. This evidence and the comparatively low operative mortality together with the utter failure of other means to combat the progress of the disease are all strong arguments for classing pernicious anemia as a surgical disease. But surgical treatment means more than merely splenectomy. The routine treatment which we have emphasized is

Multiple massive transfusions of whole blood eradication of all local foci of infection present laparotomy for removal of the spleen and other tissues showing evidence of chronic infection.

Even though no ultimate cures may result it seems that the work is worth while that it offers at least the quickest and most certain method of obtaining a remission of the disease even in some of the extreme and long standing cases.

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CANCER OF THE LARGE BOWEL<sup>1</sup>

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THE recognition of the ravages of malignant disease by our profession and by the laity is manifested by the interest and energy directed in all countries toward a solution of the many problems associated with its origin and dissemination. During the past quarter of a century no disease has been studied by greater minds and the research workers in no other disease have received greater encouragement and financial aid from governments and scientific associations. We have learned much concerning its growth and development but its etiology is still a hidden mystery.

Two facts have slowly emerged however: first the importance of mild continued irritation as an etiological factor and second the loss of immunity. The Imperial Cancer Research have noted the increased frequency of incidence with age. Examples of irritation need only be mentioned: the cancer of the groin in chimney sweeps, of the cheek in betel nut chewers, the Kanger sores in Cashmere, the oesophageal cancer from the irritation of hot rice in the men of China and its absence in the women of China who eat after the men when the rice has cooled, of sharp teeth to cancer of the tongue, of calculi to cancer of the bile passages and kidneys and of benign neoplasms to cancer of the breast. Chronic irritation after immunity is lost, is disastrous.

When we turn to cancer of the intestine we find that the disease is found in the large bowel in 95 per cent of the cases. The large bowel has a valve at each end and the content is of a higher specific gravity than the content of the small intestine and therefore better adapted to cause irritation. In addition there are four rather constantly fixed points at which the passing content might be delayed. We find further that cancer of the large bowel shows a predilection for those areas in which delay or stasis commonly obtains.

Scientific interest in the function of the large

bowel may be said to date from the discovery of the ileocaecal valve by Caspar Barlow in 1579. John Hunter at the time of his death was engaged in the study of a collection of ileocaecal valves taken from a variety of animals. Metchnikoff contributed a valuable study of the bacterial flora of the colon and attributed to their action many of the ills of man. Anatomists, bacteriologists, physiologists and physiological and pathological chemists have added their quota to the general fund of information and Roentgen's discovery has rendered possible more accurate observation and study of the stomach and the whole of the intestinal tract.

Whether malignant disease is more common in our day than in the past is a debatable question. There are reasons for thinking that it is. In the Royal Victoria Hospital, Montreal, a larger number of cases of malignant disease are admitted each year. During the year ending June 1916 there were admitted as many cases of cancer of the intestine as during the three previous years. The average age of the patients has remained about the same during a period of twenty-two years. I understand that other hospitals have a similar experience to record.

Why does carcinoma develop more frequently in the large than in the small bowel? The anatomical curves of the large bowel, the normal delay of content, the multitude of bacteria, favor stasis and stasis favors irritation. In two comparatively recent cases of cancer of the duodenum observed in the Royal Victoria Hospital, the growths were annular and in the region of the papilla of Vater. They involved the papilla, caused obstruction of the bile duct and cystic dilatation of the same. Two instances of cancer of the jejunum were in neither characteristic.

Embryologically the colon is a more recent structure than the small intestine. The most primitive parts of the digestive tube of vertebrates, omitting mouth and anus, are the pharynx and the small intestine. The

pharynx undergoes great changes in the vertebrate series but the small intestine maintains in principle its uniform character throughout. The lamprey, representing the most primitive craniate vertebrates, has no differentiated stomach and no colon. In the intestine there is a longitudinal valve with a slight spiral twist. The intestine with the spiral valve in the primitive cartilaginous fishes is the small intestine. The large intestine is very short and has a small dorsal rectal caecum. The spiral intestinal valve in its quality of increasing the epithelial surface is replaced in higher forms by ridges and villi.

In some bony fishes which have no spiral valve the boundary between small intestine and large is marked by an ileocecal valve corresponding to the ileocolic or ileocaecal valve of higher forms. In these fishes the large intestine devoid of differentiation between colon and rectum is very short (e.g. the angler fish).

In the frog the large intestine is sharply marked off from the small intestine by a constriction but has no differentiation into colon and rectum.

The small intestine is older than the stomach and the stomach is older than the colon. The esophagus is intermediate between pharynx and the stomach in position and age.

In the embryonic development of mammals and man the small intestine forms its loops before the large intestine begins to lengthen appreciably.

It must be borne in mind that comparatively recent organs are often more highly differentiated than more ancient organs. The stomach of ruminants and the esophagus of birds are more highly organized than the same parts in man. Professor Willy has pointed out that the small intestine is not more highly differentiated than the colon in consequence of its greater antiquity but has conserved its primitive and fundamental properties throughout. It is therefore not a greatly specialized organ but it is a *persistent organ* retaining many primitive features including considerable plasticity and power of regeneration. This may throw light on its relative immunity from carcinoma. The colon on the other hand is of more recent

formation and possibly less resistant to chemical bacteriological and mechanical irritation. The alimentary canal of man is molded in response to an omnivorous diet. By changing and regulating the diet parts of the canal notably the stomach and colon can be dispensed with. Lynch, Draper and Lyons think that the stomach and cecum have but two important functions, those of storage and motility. It does not seem clear that embryology can throw much light on the causation of cancer of the large bowel or at any rate do more than suggest that perhaps by virtue of its age and differentiation it may possess less resisting power to change than the older and more persistent small bowel.

The causative influence of irritation of the large gut by masses of more or less dry and hardened feces cannot be dissociated from that of enterostasis. We are now familiar with the mechanical or as it has been called the drag hand and kink theory of Sir W. Arbuthnot Lane who by the way was the first to draw attention to vocational changes in the skeleton taking the old miner as an illustration. His views have been stimulating and suggestive. The idea that enterostasis is the result of defective or altered innervation rather than to mechanical causes is very ably presented by Professor Keith. He first indicates that at three points in the large intestine there is normally a delay: (1) Near the commencement of the transverse colon leading to the filling of the cecum and ascending colon; (2) at the rectocolic junction leading to accumulation in the pelvic colon; (3) above the anal canal leading to accumulation in the rectum. It is to be noted that these points of normal delay correspond with the more frequent sites at which malignant disease is found to occur. A systematic study of the mesenteric plexus has convinced Professor Keith that it is not a simple structure composed merely of nerve cells and nerve fibers but one of a composite texture. There are ganglion cells in the plexus and there is an ample network of particularly fine fibers. But there is also an abundant third element in the plexus—the branching intermediate cells which have been already mentioned and which appear to become con-

tinuous with processes of certain groups of muscle cells on the one hand, and with the branched processes of ganglionic cells contained in the nerve fibers of the plexus. This he calls nodal tissue. It is found about the ileocolic junction in the distal part of the transverse colon in the descending and ileocolic colons and in the rectum. That situated at the ileocolic junction is regarded as the pacemaker of the rhythmic contractions of the colon in the same sense as the sino auricular node is the pacemaker of the heart. Defective innervation means defective muscular action and abnormal excessive or inefficient peristalsis. I mention excessive because many clinicians have found increased tonus amounting in some cases to a spastic condition of the intestinal musculature in colic constipation. Again ileal and colonic stasis is frequently accompanied with ptosis of stomach, small and large intestines. New light is thrown on this association of enterostasis and ptosis by Sherrington's discovery that stimulation of the splanchnic nerves threw the abdominal musculature into tonic contraction. Geddes, Keith and others have shown that the normal support of the abdominal viscera are the pelvic and abdominal muscles and Keith believes that these muscles are called into action when the erect posture is assumed by reflexes arising in the abdominal viscera and that the folds of peritoneum or ligaments only act when the normal muscular support becomes insufficient. Starling and Bayliss teach that there are two circulations in the intestines each under nervous control, one sending the blood along to the portal vein and one acting on the intestinal content.

Does it not seem highly probable that the two theories regarding the pathogenesis of intestinal stasis, the nervous theory of Keith and the mechanical theory of Sir Arthurbot Lane, are intimately related, indeed, that the mechanical condition so obvious in fully developed cases may be a sequel to an earlier failure of the normal neuromuscular support. The erect posture of man makes a heavy call on the pelvic and abdominal muscles to support the stomach and intestines and it is equally evident that to do their appointed

task they in turn must receive a nerve supply approaching the normal in quantity and quality. Whether we accept Sherrington's idea that the upright position more than any other has fixed the short limits of man's life as correct, or not, we may subscribe to the thought that the erect position of man under present conditions of life favors in many people the appearance of misplacement of parts of the colon that are commonly found associated with malignant disease of the large gut.

The importance of stasis has long been recognized and the predilection of cancerous growths for places in which accumulations and stagnation of faeces readily occur or in which the movement of faeces is made difficult by their consistence and the anatomical construction of the gut seems to be established. Obviously these conditions obtain in the large gut especially in the neighborhood of the caecum, hepatic and splenic flexures, the sigmoid and rectum to a greater extent than in the small gut. The idea is clearly expressed by Oertel in the following words: "It can not be claimed that stasis is a direct cause of cancer. Its action is more probably an indirect one favoring ulcerative and other inflammatory lesions by which the structural and cellular balance of the gut is upset. Of these changes ulcerations appear of greatest importance. It has been recognized for some time that cancers develop much more frequently in locations in which ulcerations (especially of the chronic, indolent variety) are apt to be seated than elsewhere. Thus in the lower parts of the bowel, notably the rectum in women, the opportunity for stagnation, ulcerations and cancer formations are notoriously greatest. The seat of ulcers in the rectum is most frequently behind and under one of the large folds of mucous membrane. There an ulcer remains indolent, often small and undetected during life unless it becomes actively infected. In one such case occurring in an elderly gentleman a large and obscure pelvic abscess formed and later on the base of the ulcer broke through completely. During the past year the Royal Victoria Hospital has had two such fatal perirectal abscesses in elderly people and it seems probable that some rectal carcinomata

take origin in the base or sides of such chronic indolent ulcers. Our pathologist Professor Oertel has studied these cases with very great care and the knowledge gained throws additional light on the relation of malignant disease of the rectum and large bowel to these chronic superficial ulcerative lesions.

What holds true in regard to these inflammatory irritations in the rectum holds true for the rest of the intestine including the small gut; thus cancers of the duodenum occur in the majority of instances in the region of the papilla of Vater; the irritation resulting from inflammation of bile ducts, pancreatic ducts or gall stones.

Interesting further is the fact that the character of the intestinal flora of the large gut has apparently a bearing on the production of ulcers. Thus Singer<sup>1</sup> found that feeding rats with their own feces produced gastric ulcers in them. The intimate relationship of certain specific ulcerations to growths is demonstrated by the investigations of Fibiger<sup>2</sup> who observed in the stomach of rats in the presence of nematodes (filaria) a carcinomatous transformation of ulcers, and Herzog<sup>3</sup> has described the development of cancer of the base of a tuberculous ulcer. Oertel points out that such observations emphasize the importance of definite but not well understood qualitative characters in ulcerative processes eventually terminating in cancer, although care must be exercised in differentiating early ulcerations in tumors from tumors originating on the bases of ulcers. Undoubtedly many mistakes result from improper critique of histological pictures. But eliminating many doubtful cases there still remain a sufficient number in which it is reasonably certain that the cancer actually followed the path of ulceration. Admitting this however there is yet the question why all such ulcerations are not followed by cancer for after all cancer is much less frequent than the various types of ulcerations which may be concerned in its etiology.

Some light has lately been thrown on this question by the finding of developmental

anomalies in the gut. These consist of small often microscopic isolated misplaced occasionally underdeveloped atypical glandular formations in the intestinal wall. These peculiar glandular structures were originally regarded and described as early tumors. Many of the so called primary cancers of the appendix reported by various writers are of this type. Continued investigation has shown that these formations are not progressive infiltrating or even growing structures but stationary misplaced quiescent often underdeveloped glands. They are not therefore true tumors but teratomata and called by some for this reason blastomatoid. They have lately become practically very important for they have often been misleading in surgical diagnosis.

The inference may perhaps be drawn that these teratoid or blastomatoid foci remain quiescent until certain specific qualitatively distinct stimuli for which they possess an affinity reach them and stimulate growth and transform them from latent into actual tumors.

This can only be offered at present as an hypothesis but it rests at least on some facts and helps us to understand why similar irritative conditions may be followed in one case by a tumor and not in another.

Whether this is the only method by which cancer develops in the bowels is of course doubtful. There are likely others and they may be found in various other pathological changes such as specific cell degeneration with inflammatory isolations of glandular parts irritated by formative stimuli but about these it is useless at present to speculate further until we possess a greater number of facts for intelligent discussion.

Recognition of the influence of the nervous system as an etiological factor in enterostasis and the relation of the latter to malignant disease of the large bowel are suggestive. The materialism of the latter part of the past century and of the present has forced a speeding up which together with the great changes that have taken place during the same period in our habits of living and in our diet may well give rise to serious thought in the minds of our profession. If we are to do our whole

duty we should not devote the whole of our energies to the routine work of healing the sick but indicate to the world a life guided by higher ideals, more rational methods of living and working and also a more sensible and healthy way of playing.

In the treatment of cancer of the large bowel early diagnosis is the first essential. There as elsewhere, carelessness rather than ignorance are responsible for the non recognition of the disease in its early and more remediable stage.

The progress of cancer of the large bowel is usually slow. The prognosis after early removal is particularly good.

I will not discuss at this time the details of the surgical treatment, but I would just

like to say that sound judgment is particularly necessary. The desire to do an ideal operation should be subordinated to the general condition of the patient. Those suffering from chronic incomplete obstruction are bad surgical risks. They appear to be in better condition than they really are. They are all toxic. Whether the toxin is of bacterial or food decomposition origin or as indicated by Draper to aberrant activity of the duodenal and probably pancreatic cells may be definitely determined in the future. In the meantime our clinical experience teaches us that drainage of the proximal distended gut is followed by an improved general condition and a hazardous surgical risk becomes a fair or good surgical risk.

## CANCER OF THE STOMACH<sup>1</sup>

By CHARLES H. PECK, M.D. of New York

CANCER of the stomach is a disease which constitutes one of the formidable problems a surgeon has to meet. Statistics show that of all cancer deaths approximately two fifths are due to cancer of the stomach and that the stomach is attacked more frequently than any other organ. To one who believes that malignant disease enters the body from without this seems a significant fact. That cancer of the stomach is in many cases curable by surgical procedures of moderate risk when seen in the early stages is an accepted fact why then should the mortality be so high and so few cases be permanently cured?

The stomach should be one of the sites most favorable for successful removal of the disease by operation. Partial gastrectomy is an operation attended by only moderate risk when performed by a competent surgeon in proper surroundings. The adjacent groups of lymph nodes are accessible and easily removed direct extension to other organs or structures and secondary deposits at a distance are often of late occurrence, and could the condition be brought to early

operation in the majority of cases the present discouraging surgical statistics would be greatly improved. The problem then is to secure early recognition of the malady and early consent for surgical treatment. To attain this end physicians and surgeons must work hand in hand. The public must be educated as to the great importance of early diagnosis and prompt treatment, and surgical procedure must be of a character to give confidence to the family physicians and patient, in the wisdom of securing skilled surgical advice before the disease has advanced to its later stages. We have only to look back for a few years to see the comparable situation in regard to the operative treatment of appendicitis and of tumors of the breast. Education has progressed to such a point in these conditions that both laity and profession demand the earliest possible treatment, instead of waiting for late and secondary symptoms which were once considered essential to diagnosis before operation could be advised. May we not hope that with increasing recognition of the danger and prevalence of the disease, of the

difficulty of distinguishing it in early stages from other digestive disturbances and with the newer aids to early diagnosis a few years will show a radical difference in the surgical statistics of carcinoma of the stomach as it presents itself to the average hospital surgeon?

Through the courtesy of many of my colleagues I have been able to collect and analyze the records of 527 cases of cancer of the stomach admitted to the surgical services of several of the large hospitals of New York City during the past five or six years. 71 per cent were males and 29 per cent females. The one glaring fact which stands out in studying this group of cases is the late and hopeless stage of a high percentage of the patients when first admitted for surgical treatment. Of the total number 408 were operated upon and in 119 no operation was done for the most part because of the advanced stage of the disease although a small number refused surgical treatment. Of the number operated upon in 143 cases exploration only was done the stage of the involvement prohibiting further operative interference in 107 cases a palliative gastroenterostomy or gastrostomy and in only 98 cases was an attempt at radical peritonectomy made. Even in the latter group many of the cases were very far from being examples of the early stage of the disease and offered little hope of permanent cure with radical excision. Summaries of the case report in the series have only been completed in 267 of the 527 cases.

The results which seem discouraging in studying the group as a whole cannot be attributed to ineffectual operative procedures but to the fact that relatively few were fit subjects for radical excision when first presenting for surgical treatment. What must be done then to secure earlier diagnosis?

The cases naturally fall into two main groups first those which give a history of symptoms of preceding chronic gastric ulcer of long standing the malignant disease being an implantation on the pre-existing ulcer. Much difference of opinion exists both as to the percentage of cancers which originate in ulcers and as to the percentage of chronic ulcers which eventually become malignant.

The Mayo clinic estimates that approximately 70 per cent of all cancers develop from chronic ulcers while Kuttner with his large experience in gastric surgery places the percentage much lower. Be the truth as it may it is an accepted fact that every such ulcer which remains unhealed is a source of irritation and if possible malignant degeneration and in consequence is a potential cancer. This does not hold good of chronic duodenal ulcers which rarely become malignant.

In every call us unhealed gastric ulcer therefore that resists medical treatment for a reasonable length of time or recurs after an apparent cure should be excised. In this way only can the earliest types of cancer be recognized and cured and as this practice becomes more universal the percentage of permanent cures from radical excision will be greatly increased. My first case of partial gastrectomy for cancer a case of this type operated upon in July 1906 is still alive and well at the age of 46 ten years and three months after operation.

In this group the early diagnosis depends not upon the symptoms of the cancer itself but on those of the preceding lesion which gives a characteristic syndrome so that there is little excuse for failure to recognize it. Unfortunately a large group of cases do not give a definite preceding ulcer history as an aid to diagnosis and if malignant implantation on an ulcer has occurred it has followed so quickly that symptoms of malignancy seem to be coincident with the beginning of the digestive disturbances. Of 21 cases in which the duration of symptoms was noted 52 per cent gave histories of less than six months duration many of them only a few weeks. Of the whole group only 19 per cent gave definite long histories of digestive disturbance suggestive of ulcer. What can be done to recognize these more rapid and insidious forms of the disease? In the first place no evidence of digestive disturbance occurring in patients past middle life previously well should be taken lightly. Every such case should be carefully studied and observed from the standpoint of possible development of malignant disease. Careful anamnesis will sometimes elicit symptoms

of previous trouble forgotten or little noticed. Of the modern aids to early diagnosis the use of the X ray in cancer of the stomach easily stands first. The routine use of this method of examination in suspected cases in competent hands will result in the recognition of many cases of the disease in early stages which otherwise could not be diagnosed. The study of gastric secretion and function is of value but has been disappointing as a means of early diagnosis. In the light of present day knowledge to wait for the classical clinical symptoms of the disease described in textbooks such as the development of tumor coffee ground vomit, hematemesis anemia and cachexia would be utterly inexcusable and like waiting for the development of abscess or peritonitis to establish a diagnosis of appendicitis.

While radiographic examination in gastric disease is a matter for experts only and in interpretation of the findings must be made with the greatest care in competent hands it is capable of making a correct diagnosis either positive or negative in more than 90 per cent of all cases.

In the group of cases studied while many radiographic examinations were made and in the majority of instances the findings were proved by operation the data are in sufficient to give percentages of the group as a whole.

Exploratory operation should be urged in all early cases in which the diagnosis of cancer or of callous ulcer is reasonably certain, and also in doubtful cases where a preoperative positive diagnosis seems impossible and yet strong suspicion exists of the presence of serious trouble. No surgeon wishes to do a negative or unnecessary exploration nor can one avoid a certain feeling of chagrin when such a result occurs nevertheless this feeling is no excuse for shirking a plain duty when all possible means of making a correct diagnosis have failed to remove a reasonable doubt as to the existence of cancer. Leaving for the moment the question of early and doubtful cases, we must consider operability in the group in which the diagnosis is all too plain and the question exists only as to the possibility of surgical relief.

Advanced cases evidently inoperable as shown by X ray by tumor cachexia secondary deposits in liver or lung should not be explored. Such operations bring no relief to the patient and no credit to the surgeon they tend to discredit the surgical treatment of gastric cancer and deter other patients with early and operable lesions from seeking surgical relief. Exploratory operation is often urged insistently by the patient's family or friends in the desperate hope of doing something and not infrequently by the medical attendant especially if he has prolonged medical treatment and failed to recognize at an early stage the seriousness of the condition. I have more than once been the victim of this effort to shift the responsibility to the shoulders of the surgeon and have been led into performing useless operations. It is of course difficult to draw the line between this group and the cases with advanced growths which are still movable without inaccessible secondary deposits and suitable for radical excision as a palliative procedure rather than in the hope of ultimate cure.

If a growth is movable does not infiltrate too widely into the stomach wall nor extend too close to the cardiac end if adhesion to surrounding structures is absent or of such a character that safe separation is possible the size of the growth is not a contra indication to radical excision nor is involvement of adjacent lymph node groups if their position and extent permit of safe removal.

The Mayo Polya method of excision developed independently and perfected by W J Mayo has made possible the safe removal of growths more extensive than one could deal with effectually by the other methods of partial gastrectomy. A small portion of the stomach near the cardiac end is all that is needed for safe anastomosis with the jejunum if this method is used.

Of the operative technique I shall say little as this subject has been so fully covered in many recent publications. One or two facts however I should like to emphasize. It must not be forgotten that the majority of these patients are poor surgical risks.



Great care should be taken in pre operative examination and preparation when radical operation is contemplated. If a marked degree of secondary anemia is present preliminary blood transfusion may be of value in increasing the resistance of the patient and lessening the operative risk. Thorough studies of renal function should be made by modern methods not trusting simply to the ordinary urine examination. Patients debilitated by inability to retain fluids for long periods owing to pyloric stenosis or persistent vomiting should be given fluids freely by rectum or subcutaneously prior to operation.

The two stage operation in debilitated patients may save many a case which would otherwise be lost by an extensive primary operation this would be applicable to growths near the pylorus associated with stenosis. Postoperative transfusion should be employed freely where it may be of benefit in tiding debilitated patient over critical periods. No class of cases require greater care and skill in surgical judgment and technique to secure a successful outcome than those suffering with carcinoma of the stomach. Of the methods of excision the favorite one with most surgeons is still the Billroth No. 2.

I have several times excised large ulcerated growths with involved adjacent lymph nodes in some cases adherent to the pancreas with complete relief of symptoms marked gain in weight and prolongation of life for from one to three years. Such results justify the acceptance of a very considerable risk of operative mortality in these otherwise hopeless cases in spite of the probability of ultimate fatal recurrence. In estimating the extent of the disease and operability in advanced cases the X ray again is of the greatest value and may save many fruitless explorations. In such cases radiographs should also be taken of the lungs for many times unsuspected multiple pulmonary metastases are present and operative deaths attributed to postoperative pneumonia may be due to this cause.

Of 33 of the radical operations in which details were obtained 23 recovered and 10 died. Of the 23 cases which recovered 8 only are known to be alive and well 3 of these at 4 years one at 2 years and 6 months and the rest at shorter periods. Several of the other cases made marked improvement after the operation and lived periods varying from 8 months to 2 years and 6 months following the operation.

Palliative gastro enterostomy should be done only when pyloric obstruction is present and of a degree to interfere seriously with the passage of food. Its mortality in the series studied was 28 per cent almost as great as that of partial gastrectomy. While it is at best an unsatisfactory procedure it will prolong life and add to comfort in a sufficient number of patients to warrant its employment in properly selected cases. It must be remembered that the majority of these patients were in the advanced stages of the disease and essentially poor risks for any operative procedure.

Satisfactory figures as to the prolongation of life after posterior gastro enterostomy have not been obtainable for the group as a whole. In general the results are disappointing though a fair number of patients seem to have had relief lasting several months.

In growths near the cardiac end with oesophageal obstruction palliative gastrostomy may be imperative to relieve starvation. This was done 17 times in the series studied with an operative mortality of 35 per cent.

Whatever method is employed it is essential for the development of this branch of stomach surgery that the operative procedures should be made as safe as possible not only for the benefit of the individual patient but for the repute of stomach surgery in general so that such surgery may be sought not as a last resort in late and hopeless conditions but in early stages when it offers a real hope of permanent cure of this most serious malady.

CANCER OF THE BREAST<sup>1</sup>

By WILLY MEYER M.D. F.A.C.S. New York  
 Attending Surgeon to the German and Post Graduate Hospitals

**A**N address on cancer of the breast before this audience must of necessity cover ground that is well known to every one present.

During the last thirty years many important papers have been written on the subject, and the vital points of diagnosis and treatment have again and again been brought before the profession, so that today this chapter of surgery is one of the best known.

Still in conjunction with the other addresses on carcinoma on tonight's program a review of the question of mammary carcinoma assigned to me may be of some interest.

Since time immemorial cancer of the breast has been the most dreaded disease of the female sex. This dread in former days was natural and easy to understand. Operation was almost invariably followed by a recurrence or rather a continuance of the disease. Besides the arm on the affected side often became painful stiff and less useful. Metastasis was very frequently seen so that the public at large was wont to consider a patient doomed as soon as the diagnosis of carcinoma of the breast had been made.

In seeking an explanation of this sad state of affairs in the past one finds many reasons.

1. The public was not educated on the subject. It did not recognize the necessity of a medical examination of a tumor of the breast promptly upon its detection.

2. The mistaken idea that a tumor which never caused pain could not be a serious malady.

3. The hesitancy also on the part of the medical profession promptly to attack the disease with the knife. Procrastination was frequently practiced. The patient was told to come back for examination and re-examination and thus weeks and often months of valuable time were lost before a definite diagnosis was established.

4. The lack of confidence in the ability of surgery totally to eradicate the trouble.

Today conditions are changed. The public has been and is continuously taught by word and print, that every tumor formation in the breast needs prompt and most careful attention by the medical adviser that a growth which has been detected by chance and never has caused the patient any pain, is to be feared more than one that has ached intermittently. The medical profession today fully understands the importance of advising prompt operation even in cases in which the diagnosis is doubtful. It has gained faith in the possibility of a cure by the knife proved as this has been by statistics compiled by the best men everywhere.

Cancer of the breast clinically appears in two pre eminent pathological pictures the scirrhus and the medullary carcinoma.<sup>2</sup>

The scirrhus invades the normal tissue and destroys it by shrinkage hence reduces rather than increases the size of the breast. The nipple of the affected side is raised above a horizontal line drawn across the chest from the healthy mamilla, with the patient in erect posture it cannot be drawn forward with the same ease as on the unaffected side, but gives the impression of being held back in the depth. The tumor may appear in any quadrant. It is irregular hard diffuse on palpation does not slip freely in all directions within the breast tissue but can be moved only with the latter. After it has grown toward the skin the latter becomes dimpled and more and more immovable over it soon infiltrated axillary glands appear.

Medullary carcinoma, on the other hand increases the size of the mammary gland. It is usually more extensive than the scirrhus. The nipple often stands lower than on the unaffected side. It, too, diffusely invades the normal tissue and thus proves its malignancy to the surgeon's fingers on first palpation. Its growth is more rapid the axillary glands

Others subdivide into scirrhus carcinoma simplex adenocarcinoma medullary and colloid carcinomas carcinoma cyst. The scirrhus and the medullary carcinoma represent the two principal types of locally.

<sup>1</sup> Read before the Clinical Congress of Surgeons of North America Philadelphia October 3-26-05

become involved at an early stage of the disease.

Mammary carcinoma as a whole takes the third place in the frequency of all carcinomata. It appears somewhat more than one hundred times as often in the female as in the male sex or stated inversely the proportion of frequency in male and female is less than 1 to 100. It has no predilection for either right or left side; it appears most frequently in the outer upper quadrant of the breast.

As regard etiology direct traumatism plays a more or less important role. It has been estimated that the disease is due to this cause in 15 to 25 per cent of the case. Hereditary influence has been charged with 5 to 10 per cent. The act of nursing also acute inflammation — mastitis — have been held responsible for the disease.

The so called chronic multiple cystic mastitis in individuals above 5 years likely represents the precancerous stage of the trouble.

Of course the real cause of cancer is not known as yet. Still in view of the exhaustive experiments with bacterium tumefaciens in plants conducted by Dr Erwin F. Smith (1, 2 and 3) pathologist in charge of the U. S. Department of Agriculture, Bureau of Plant Industry, Washington, it looks as if we might know definitely sooner than we had dared to hope a few years ago. If what seems to be proved in plants holds good in man, we shall know that cancer is due to an infection either bacterial or parasitic. What many surgeons have maintained for years, viz. that cancer *will* prove to be an infectious disease, seems gradually to be becoming a tangible entity. In the face of what Professor Smith's investigations have shown the time seems rapidly approaching, as Smith emphasizes, when pathologists will have to abandon Ribbert's explanation that cancer is due to a subepithelial inflammation induced by substances arising in the epithelium which cause it to be less well differentiated and to grow downward, as well as Cohnheim's cell rest theory so tenaciously held to for many years and concentrate their united efforts in conjunction with the experimental biologist and the bacteriologist upon finding the infecting agent in man.

Certainly carcinoma of the breast the same as every other cancer occurring in man is at first an absolutely localized disease. In the second stage it infects the lymphatic glands in its anatomical region. In the third stage it transgresses the regionary border lines and becomes generalized — it forms metastatic tumors of the same microscopic type in other parts of the system. When this stage is reached the disease is beyond the help of surgery.

If we assume carcinoma to be of infectious (parasitic) origin many phenomena in the surgeon's daily clinical observation of patients afflicted with carcinoma will find a logical and comparatively easy explanation. The cure of a cancerous growth even in the third stage would then appear a not altogether hopeless task. The metastatic tumors might be brought to dissolution by means of a serum prepared in the laboratory according to modern principles. Or if this failed chemotherapy developed for this particular chapter as salvarsan was for syphilis after the spirochete had been found to be the etiologic factor might produce absorption. But for the present science has not advanced that far. All these possibilities are as yet but a vision, still a vision the realization of which seems to have come within our reach by virtue of Erwin Smith's wonderful work. Surely his striking experimental results should be seen and studied by every medical man interested in this question.

Let us hope that the man who will prove for the animal kingdom what the Washington scientist seems to have established for the vegetable kingdom lives amongst us now!

If carcinoma be the result of an infection — and in view of its definite curability by operation this infection must be a local process primarily not a general one as many still believe — or if local atypical epithelial cell proliferation as we believe today be the etiologic factor, the early and radical local destruction appears to be the only logical procedure from a therapeutic point of view. At the present stage of therapeutic evolution

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this local destruction is best done by means of an operation, provided the latter can be made truly radical and can be carried out in such a way that the infected area is never entered.

For carcinoma of the breast a radical operation has been at the disposal of surgery for the past twenty two years.

Still operation must not necessarily remain the principal procedure for the definite destruction of a new growth. It is conceivable that in the future as just stated chemotherapy or serology in combination with physical treatment (X ray radium artificial hyperæmia) may take the lead in the therapeutics of carcinoma. Today our efforts in these directions are purely empirical. However once the supposed infectious organism of the malignant tumors of mankind is found the way will have been opened for true scientific exploration. Happy the medical men who will have the privilege of practicing in that era!

#### HISTORY OF THE RADICAL OPERATION FOR CANCER OF THE BREAST

The operation for carcinoma of the breast has had a typical evolution. Clinical observation had demonstrated that the axillary glands into which the lymphatics of the mammary gland discharge as long as the skin has not become involved in the disease become affected at a comparatively early period. The postulatium therefore was to remove the enlarged axillary glands with their surrounding fat simultaneously with the extirpation of the breast (von Volkmann, 1875). It was further observed by von Volkmann that, if the cancerous breast was dissected off the fascia which covers the pectoral muscle local recurrence of the disease very frequently occurred. The microscope furnished him the clue for this clinical experience. It showed that a great number of the mammary lymphatics run down to the pectoral fascia, so that in the presence of carcinoma cancer cells are carried into it.

The muscle itself however remains free from the disease for quite some time. The explanation for this phenomenon was found in the fact that there is not as a rule a free communication between the lymphatic system of the muscle and that of the fascia covering it. On basis of these findings, von

Vollmann (4) further advised removal not only of the entire breast with a liberal piece of skin plus axillary glands but also of the entire fascia of the pectoralis major muscle.

Kuester of Berlin (5) generalized von Volkmann's advice and demanded the cleaning out of the axilla in every case of breast tumor whether glands were palpable or not (1883).

In 1885 A. G. Gerster of New York (6), suggested reversing the direction of the dissection. He believed the unavoidable handling of the tumor by the operator's hands and the assistants' hooks to be associated with the risk of forcing cancer cells into the lymphatics and thus disseminate the disease through the body. Accepting this reasoning primary cleaning out of the axillary cavity with subsequent ablation of the breast plus pectoral fascia henceforth became the choice of many operators. Still the results as far as recurrence was concerned were not improved by this procedure.

A few years later (1889) Heidenhain (7) on basis of a careful microscopical analysis of eighteen specimens removed by Kuester substantiated von Volkmann's findings in every detail and showed that in a great number of cases of cancer of the breast the pectoralis major muscle is also involved by the disease. In order to avoid recurrence of the growth he advised extirpation of the superficial layer of the great pectoral muscle together with the cancerous breast in all cases in which clinical examination showed the tumor not adherent to this fascia but the complete extirpation of the pectoralis major muscle if the tumor was not freely movable over it.

In order to be on the safe side it soon became customary with surgeons first to clean out the axillary cavity and excise the breast dissecting it off the pectoral fascia, then to extirpate the pectoralis major muscle, or both pectorals this muscle extirpation forming the second part of the operation.

The year 1894 witnessed the appearance in medical literature of two radical methods of operation for cancer of the breast, that of William T. Halsted of Baltimore, and that of Will. Meyer of New York. Both operations had been conceived independently and by a peculiar coincidence both were

presented to the medical profession within the space of ten days — the first in print (8) the latter orally — in November 1894 Willy Meyer (9) had announced a paper to be read before the Surgical Section of the New York Academy of Medicine on November 12 entitled "An Improved Method of the Radical Operation for Carcinoma of the Breast." It had reference to an operation done on a private patient of his in September 1894, according to a plan that had developed in the author's mind on basis of the study of the operations above mentioned and founded also on the author's firm belief — firm then as well as today — that malignant tumors are due to a local infection parasitic or microbic.

Since the publication of Hedenhurs's experience showing that the large pectoral muscle if left in place was often the seat of a local recurrence Willy Meyer too had made it a rule in his operations for cancer of the breast to remove this muscle *after* the affected breast had been excised. At one of these operations — done at the home of a patient who was rather stout — quite some blood was lost in the course of the removal of the large gland and the dissection of the axilla. During the subsequent extirpation of the pectoral muscles many of the formerly divided vessels had as usual to be cut and tied for a second time. It was a cold winter day and the room in which the operation was done was not very well heated. The prolonged exposure of the upper part of the body with the unavoidable loss of body temperature added to the depressing effect of the operation. Stimulants were therefore freely used after the patient had reached her bed and she rallied nicely. But a few hours later a messenger brought a hurry call — there were no telephones at that time — from the nurses who were left in charge of the case with the statement "patient in collapse." The operator at once repaired to the patient's bedside and administered an intravenous infusion of saline solution. However it was too late. The patient died.

This sad experience persistently haunted the operator and it then occurred to him that it might be an advantage always to remove the two pectoral muscles *with* the tumor plus

lymphatic glands and fat *in one piece* and thus leave the cancerously infected area undisturbed with all parts in their normal anatomical relation to each other. He was convinced that such a procedure would not only greatly reduce the loss of blood and shorten the time of operation but materially add to the radicality of the operation. Incidentally the chance of infecting the patient's system with cancer cells would be considerably lessened.

It was his hard luck not to get a single case of cancer of the breast either in private practice or at the hospitals with which he was connected at the time until nine months later September 19 1894. Then for the first time he did the operation he had evolved upon a private patient suffering from an extensive scirrhus with involvement of the axillary gland at her residence. Primary union was obtained and the patient is alive well and hearty today twenty-two years later with uterine having needed no additional operation for recurrence.

It was upon this case that the author based his paper to be read before the Surgical Section of the New York Academy of Medicine on November 1 1894 (9).

Just a few days before the meeting of this body the November edition of the *Annals of Surgery* came out containing W. S. Halsted's article entitled "The Results of Operations for the Cure of Cancer of the Breast performed at the Johns Hopkins Hospital from June 1889 to January 1894." The writer thereupon made a brief abstract of this paper pointing out the principal differences between the two operations and read it as a *post scriptum* to his own paper presented at the meeting of the Surgical Section.\*

In the course of the following years both operations were faithfully tried by many surgeons. Willy Meyer decided to wait ten years from the date of the publication of his first paper before reporting further results obtained with his method and then to compare them if possible with those obtained by the Halsted method of operation.

The second patient operated upon by this method all years old at the time of the operation on May 1 1894 is perfectly well today twenty-nine years later.

The author's course appeared twice in the paper upon its publication in the New York Medical Journal and September 1 1894.

It was perhaps injudicious to defer publishing anything further on the subject in the shape of an article, for my first paper it seems was thereby lost sight of.<sup>1</sup> The points of difference between the Halsted and the Willy Meyer operation did not become generally and clearly established in the minds of surgeons. Many did Willy Meyer's operation and called it Halsted's. Others called Willy Meyer's operation a modification of or improvement on Halsted's operation. This would, of course imply that its author had known of Halsted's procedure and then set to work to modify or improve upon it, — which is not in accordance with the facts.

The ten years passed and in 1904 a paper was announced by Willy Meyer to the Section on Surgery of the American Medical Association, entitled Ten Years Experience with the Radical Operation for Cancer of the Breast. But the program was filled the paper could not be accepted and when, a few weeks before the meeting a vacancy occurred and Dr Charles A. Powers of Denver, Colorado then chairman, courteously asked Willy Meyer to take advantage thereof the latter had to decline as he did not feel that in the short time left he could write the paper in such a way that it would do justice to the subject. However during the discussion of the papers on diseases of the breast, he was permitted to present briefly the vital points of his method of operation (10).

So it was not until July 1905 that the paper (11) which had been planned for presentation at the Atlantic City meeting a year before was published in the *Journal of the American Medical Association* under the title Carcinoma of the Breast — Ten Years Experience with my Method of Radical Operation.

The word 'my' was inserted rather against the author's inclination. Still it seemed essential in view of the fact that shortly before an essay had appeared in the *Annals of Surgery* in which the identical procedure was described and illustrated without any mention being made of the previous existence of

the operation (J. Collins Warren). That author there states that he has lately 'adopted' this method of operation but he does not especially mention that the method which he had adopted was originated and first recommended by Willy Meyer in 1894.

Since that time quite a number of names have become linked with the radical operation for carcinoma of the breast, so that at first glance this chapter appears today almost bewildering. A busy man who has not the time to make a careful study of the literature hardly knows where he stands when he reads of the operations of Halsted, Willy Meyer, Warren, Jackson, Handley, Rodman, Kocher and Rotter. Through the efforts of a few men principal among them being Parker Syme of New York City (12) light has been thrown on this muddled chapter and the seemingly obscure subject has become clear.

The matter in reality is extremely simple. The radical operation for cancer of the breast is divided into two distinct parts, one dealing with the deep tissues and one with the skin. The first involves the principle of the operation and is represented by the Halsted and Willy Meyer procedures, the one is worked out from the sternum to the axilla (Halsted), the other one from the axilla to the sternum (Willy Meyer).

The skin incision required properly to expose the diseased focus and arrange for closing the resulting defect has been varied by a number of colleagues, and according to this variation of the skin incision the name of the respective authors has been attached to the operation. Only Handley of London has made an addition to the deep operation as well inasmuch as he extirpates also the upper portion of the anterior fascia of the recti muscles together with the pectoral mass (13). Of the other European authors who have been quoted in this connection Kocher has never claimed to have devised an operation of his own while Rotter of Berlin more than a year after Willy Meyer's operation had appeared in print published independently an almost identical procedure (14).

The accompanying cuts well demonstrate the different phases of the two radical operations and the various incisions. They are as

The reports of presentations of papers operated upon by this method and shown before the New York Surgical Society during the interval were of course embodied in the Transactions of the Society and appeared in the *Annals of Surgery*. Other surgeons also mentioned the operation in the course of the work.

a matter of necessity, but reproductions of previously published illustrations. Still thus compiled they give a good idea of what has actually been done.

# 1. TECHNIQUE OF THE TWO TYPES OF RADICAL OPERATION

1. *Hallsted's operation.* The principal steps are: Circumcision of the breast at its base (Fig. 1); continuation of the cut along the inner border of the gland up to the attachment of the pectoralis major tendon on the humerus. Reflection outwardly of the triangular flap of skin thus formed back to its base line *ca*. Primary severing of the origin of the pectoralis major muscle *viz* its insertions at sternum and ribs (Fig. 2). Entering the space between the clavicular and costal portions of the pectoralis major and splitting of the muscle up to a point about opposite the scalenus tubercle on the first rib. At this point the clavicular portion of the pectoralis major muscle and the skin overlying it are cut through close up to the clavicle *cap*, *sn*, the apex of the axilla. The loose tissue under the clavicular portion of the pectoralis major (the portion usually left behind) which is rich in lymphatics and sometimes infiltrated with cancer is carefully dissected from this muscle and the splitting of the muscle continued out to the humerus. The part of the muscle to be removed is cut through close to its humeral attachment. By raising the whole mass circumscribed by the original skin incision the submuscular fascia is put on the stretch and stripped from the thorax close to the ribs and from the pectoralis minor muscle including if possible the delicate sheath of the latter. The minor muscle having been exposed is divided at right angles to its fibers a little below its middle. The tissue more or less rich in lymphatics and often cancerous over the minor muscle near its coracoid insertion is divided as far out as possible and reflected inward while this part of the minor muscle with the clavicular portion of the pectoralis major muscle are reflected upward with a broad sharp retractor. Then follows separation and ligation of the small blood vessels close to the axillary vessels under the minor muscle and the extirpation of glands

and fat from the subclavian vein and axillary vessels from within outward. Further details will be found in the original article.<sup>1</sup> The two halves of the pectoralis minor muscle are re-stitched.

By working from the sternum toward the humerus the course of the lymph current is followed and the blood vessels of the breast are of necessity repeatedly encountered. Besides the operator enters the space between the two muscles in which cancerously affected lymph nodes and lymph vessels are not infrequently met with.

2. *Willy Meyer's operation.* The original incision reached from the insertion of the pectoralis major tendon through the axilla to the breast surrounded same at base and ended in a horizontal sweep over the sternum (Fig. 3). An additional cut ran from this wound to the clavicle meeting it at its middle.<sup>2</sup> Later in 1898 the cut was made to run about one half inch above the border of the pectoralis major muscle before reaching the breast (Fig. 4). The additional incision to the clavicle was given up only an upper and a lower skin flap are formed which does not include the fascia. The lower flap is widely undermined. If one of the lower quadrants of the breast is involved the incision is carried down toward the umbilicus and the anterior sheath of the rectus muscle is removed with the mass according to Handley (Fig. 5).

By reflecting the skin flaps with as little fat tissue attached as possible proper exposure of the diseased focus is obtained.

Now the anatomical landmarks are first exposed *above* the tendon of the pectoralis major muscle, cephalic vein and clavicle (Fig. 6) *below* and on the outer side the border of the latissimus dorsi muscle and bundles of the serratus anticus major with the chest wall sometimes also the rectus fascia inwardly the sternum.

The primary division of the entire pectoralis major tendon (Fig. 7) which now follows, necessarily entails the extirpation of the entire pectoralis major muscle the same occurs with the minor at the coracoid process (Fig. 8). The space between the two muscles

<sup>1</sup>Ann Surg Phila 1894 200  
The original article on this breast re- used by Father Syme to date  
F Co on Warren has it adopted

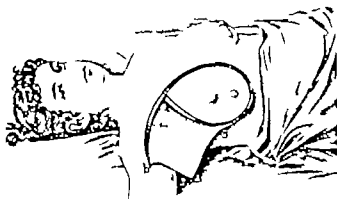


Fig. 1. Halsted's radical operation incision upper skin flap turned outward. [Figs. 1 and 2 are copied from Halsted's article in the *Annals of Surgery*, 1894, 19, 49.]

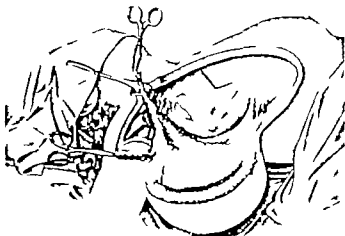


Fig. 2. The mass primarily divided at sternum and rib has been turned outward.

is not entered. The pectoral muscles are drawn inward, the deep axillary fascia is divided transversely and the axillary vessels are exposed. After transverse division of the fat which enters the bicipital sulcus at the arm (Fig. 9) the vessel branches which leave the axillary artery and those which enter the vein are bluntly approached with a scalpel handle or closed scissors or a gauze mop. All these vessels are doubly clamped and then divided in between, following from outward inward the lower border of the axillary and subclavian vein up to the point where it dips beneath the clavicle (Fig. 10). The nerves which enter the pectoral muscles with the vessels are first cut separately. The subscapular nerves are preserved if possible. The subscapular fat is thoroughly cleaned out. In this way the chest wall is quickly approached from the side and the lower surface of the pectoral muscles reached. Fat with glands and lymphatics are nowhere cut into but remain in one piece and attached to the outer lower border of the muscles in their normal anatomical relation. While an assistant gently elevates the mass and pulls it inward the division of the origin of the muscles close to the chest wall is done (Fig. 11). This finishes the extirpation of the carcinoma.

Whenever possible a short stump of the pectoralis minor muscle is allowed to remain (Fig. 12) — its belly has never been found invaded by malignant cells as long as the tumor removed remained movable toward the chest — in order to reduce in size a re-

sulting defect and facilitate grafting upon it. Otherwise the pectoralis minor muscle is cut close to the ribs. The perforating arteries are cut if possible after clamping below the under surface of the muscle before the pedicle of the entire mass thus formed is amputated alongside the border of the sternum. For details see *Journal of the American Medical Association*, 1905, loc. cit.

Drainage is done first alongside the cephalic vein and the stump of the tendons of the pectoral muscles at the upper extremity of the wound over the arm and second of the axillary cavity through a stab posteriorly (Fig. 13).<sup>1</sup>

The wound is closed without grafting if possible. The widely undermined lower flap is shifted inwardly. Silk-worm gut retention sutures bring the extreme edges of the flaps into apposition so that if pressure gangrene results from tension of these sutures it is limited to as small a portion of skin as possible.

Often the wound border of the lower flap is longer than that of the upper. This difference in length is overcome by shifting the border of the lower flap on the shorter upper one (Fig. 14) or by stitching its superfluous material in the shape of a fold sometimes forming

<sup>1</sup> Here two or three rubber tubes, split longitudinally in the shape of gutters, are introduced, the lower end being fastened with loosely tied catgut suture to one of the intercostal spaces. Inasmuch as retraction of the chest wall may occur after the lower extremity of the upper flap, the second gutter drain is made to run up the third or second rib, the paraxial line. In fleshy patients the third gutter drain of small caliber is allowed to rest in the groove between chest wall and skin flap running over the front. All drains are shortened at the time of the first dressing (about 3 or 4 days after the operation) and removed at the time of the second dressing (about 10 days later).

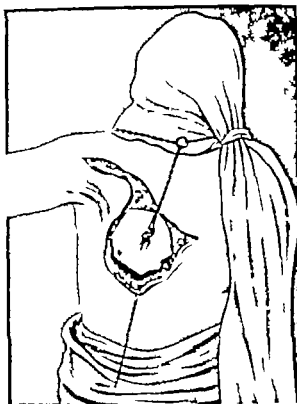




Fig. 3. I on of W. M. er rud al i rat  
first d. sed 804. Th d (t d) ne h t  
int the sup. la. ula of f il ren al f  
filtrated gland



Fig. 5. W. M. er on as d ne at pre ent. T  
horizontal rd rep turned do ar! order to  
f il tat ex m of the ant. or al th of the recti muscles  
accord ng t Handley



I 4 W. M. mod i ne on as pect ced  
th f 1908 [I 4 t 3 and b t h re taken from  
Med J Association July 20 1902]

a sort of nipple which however usually lies eccentric (Fig. 1). If the skin defect is too large to allow of closing the wound by stitches through out a continuous catgut suture first approximates the flaps outwardly from the arm downward a far is possible without causing tension interrupted catgut stitches close the inner angle of the wound as far as this is feasible again without tension (Fig. 13). A second continuous catgut suture pulls and firms the border of the skin defect to the stump of the pectoralis minor muscle thus materially reducing its size (Fig. 16). Where muscle substance of the minor pectoral is missing interrupted mattress sutures of catgut press the skin wound border against the intercostal muscles. With the defect thus prepared skin grafting from the thigh of the affected side or from both thighs completes the operation (Fig. 17).

If the wound can be entirely closed by suture the arm remains abducted outside of



Fig 6 The two skin flaps turned back border of latissimus dorsi cephalic vein and clavicle with the sternoclavicular articulation the landmarks exposed



Fig 7 Insertion of pectoralis major muscle exposed Operator's left index finger encircling its tendon

the dressing. If grafting becomes necessary the arm is included in the dressing. The grafts certainly take better if all movements of the arm are avoided during the first few days. Gymnastic exercises are then started not later than eight or nine days after the operation and continued until the posture of the statue of liberty is obtained (Figs 18 and 19). This is always insisted on.<sup>1</sup>

The radical operation for carcinoma of the breast as it is here described is an American operation. It was conceived and developed on American soil. It represents an anatomical complete and typical procedure which can be carried out speedily and with little loss of blood. The operation is such I believe can technically not be improved upon.

In order to afford the reader a clearer survey of the principal points of difference between the two radical methods of operation as published in 1894 the following comparative statement has been arranged

#### HALSTED'S OPERATION

The skin incision begins at the base of the breast surrounded with cut the anterior part of which contains upward to the pectoral major tendon. The transverse flap is reflected outwardly from the breast. Then the lower skin flaps cut and are dissected back.

The dissection begins at the sternum and goes upward and outward the direction of the lymph current.

The pectoral major splits its clavicula part on is preserved.

The space between the pectoral muscles entered and the fat (the lymphatic vessel and gland dissected off the lower part of the pectoral major).

The pectoral major muscle split transversely and laterally up edge.

The blood vessels of the branches are dissected by the operator's finger encountered in the axilla and the axilla.

The pedicle forms out by the posterior of all of the axilla.

#### WILLY MEYER'S OPERATION

The incision begins at the pectoral major tendon and extends over the sternum surrounded with cut the base of the breast.

The flaps are thus formed an upper and lower one which are dissected back with only the lower the anatomical landmarks cut.

The dissection begins at the sternum and goes upward and outward the direction of the lymph current.

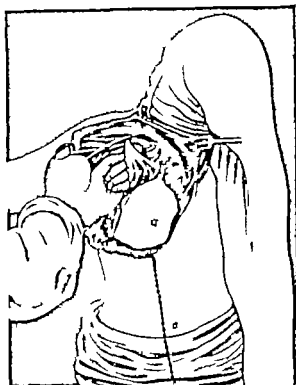
The pectoral major splits its clavicula part on is preserved.

The space between the pectoral muscles entered and the fat (the lymphatic vessel and gland dissected off the lower part of the pectoral major).

The pectoral major muscle split transversely and laterally up edge.

The blood vessels of the branches are dissected by the operator's finger encountered in the axilla and the axilla.

The pedicle forms out by the posterior of all of the axilla.



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I g S l l a n n d      Mary      f D      p e d  
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 t a r l      l b g t a l t      l t n o n      l l a r

## II. VARIATIONS OF THE SKIN INCISION

1. *Warren's incision* 1934 (15). The author adds to the skin incision shown in Fig. 3 a posterior cut through the skin on the outer side of the pectoral region (Fig. 6). It runs on a line drawn first at a right angle to the posterior incision which surrounds the breast and gradually sweeps around until it becomes parallel to it and terminates at a point a little below the level of the lower margin of the wound. The flap is intended to be turned into the lower portion of the wound (Figs. 1 and 2). In every other respect the operation described by Warren is identical with that of Willy Meyer (9 and 16). Comparing the method with that of Halsted Warren (15) says:

bel i n t i t h i l a n r e c o m m e n d a s b o t h  
w a f a n d t h r o u g h s e b e u s e f o l l o w g  
t h o u s t m o c l i n e t h e r u s a l s a r e d i d  
t h a r p o t f o g t h e b e g i n n i n g o f t h e l e a p  
d e s c r i o n i n h a m o r t h g e s t u s c o t r o l l e d t h  
o u t l u l y l o g a t h o p e r a t i o n w h i l e t h e  
g r e a t t r i f t h u n i s n o t e x p o d u n t i l  
t h e l o w o f t h e p e r m i t n T h o r o u g h b a u s e t  
p e r m i t o f a f r e p r e d e s c r i o n o f t h e  
w i l l j t h e j t f t h e l a p p o f t h e  
w i l l j t h o u s o f l y h a t i c g l a n t n e t h e  
l e l e f e r t h m a s t o l r e m i t h a s b e c  
d i s l i g e l f r o m i t s t h i n e t a n d l l o e l i  
n i e r e t h i n e t n u l r e l a o u s o f t h e t r a t

2 Jackson's incision 1905 (18 and 19)  
Jackson's incision represent an ingenious  
plasty in which the skin material beneath the  
clavicle is used to cover the defect (11  
23 to 26)

The danger exists that in order to carry his point the operator preserves more skin than the condition of the breast permits. It seems that this plastic is not done as often nowadays as it was the first years after its publication.

In the great portion of the second series the methylation in the Habel operation was consequently followed. It is, however, evident from the past year's lab. that the method gave

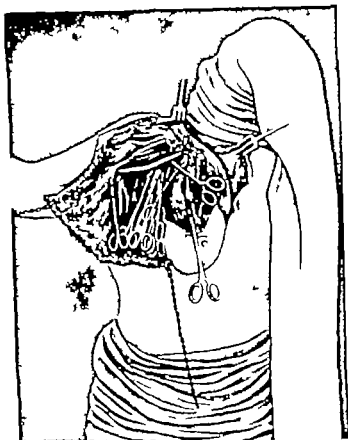


Fig 10. Axillary fat and glands stripped from lower surface of vein trunks. Muscles turned inward and do inward artery forceps in place inasmuch as ligation is done at completion of operation



Fig 11. Pedicle of mass over sternum ready to be cut off

The deep operation is the same as Willy Meyer's

3 *Handley's incision and addition 1906* (13) W S Handley of London takes the center of the growth not the nipple as the central point of the operation area. The skin incision surrounds this center in the shape of a ring and continues with a curvilinear incision above and a linear incision below (Fig 27). The latter passes downward for about 2 inches along the linea alba; it gives access for the removal of the deep fascia over the upper part of the abdominal wall viz of the anterior sheath of the recti muscles on both sides of the middle line. The deeper subcutaneous fat with the deep fascia is removed to the extent of a ten inch circle. This is done in such a way that while the skin flaps are strongly retracted by the assistant in cision through the fascia is made close to the base of the skin flaps and the fascia dissected

all around the field of operation in the shape of a wide marginal fringe. Handley believes that the wide and careful removal of the deep fascia in the epigastric region is imperatively called for in order to prevent the access of cancer cells to the peritoneal cavity.

Handley also removes the whole of the great pectoral muscle as done in Willy Meyer's operation. In every other detail he follows Halsted's procedure working from within outward.

The wide removal of the deep fascia represents an integral part of the radical operation and has been practiced in America from the very start. With reference to the excision of the upper portion of the recti sheath this to my mind appears *clearly indicated* in cases in which the lower quadrants of the breast are affected by the disease and the cancerous infiltration runs close to the mammary thoracic skin fold.

Although I have quite a number of patients who have remained well and free from recur

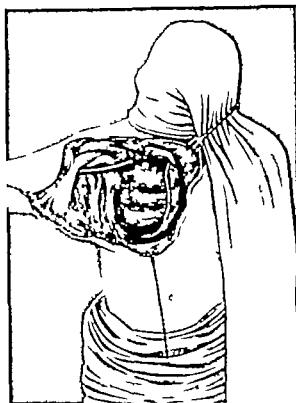


Fig. 2. Operative field after removal of the tumor. Stump of pectoral muscle visible.

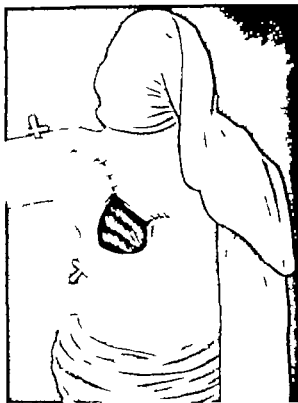


Fig. 3. Dr. W. J. B. Bertelsdorf's method. Within the resulting defect, which is not yet closed, the stump of the left fifth pectoral muscle is visible.

rence for many years without this additional excision having been employed. I nevertheless consider it wise to adopt the lower part of Handley's skin incision combined with removal of the upper part of the anterior rectus sheaths *in the crural instance*. It undoubtedly tends to render the operation still more radical for the point in question is not because case X and Y got well after the radical operation without this additional incision and excision, therefore the latter are unnecessary. The question rather is how many patients may have developed intraperitoneal metastasis because part of the anterior rectus sheaths was not removed at the time of the first operation. While of course this question cannot be definitely answered, it seems plausible to assume that Handley's addition of rectus fascia excision to the radical operation likely offers a further safeguard against intraperitoneal metastasis and should therefore be adopted. The downward sweep of the inner extremity

of the skin incision in place of the horizontal as practiced in Willy Meyer's operation is advisable also from a technical point of view because it leaves the two skin flaps more movable and consequently better adapted for primary closure of the entire wound by sutures.

Should the defect be too large to be closed by stitches (Fig. 8) and the operator not care to graft, he may do a plastic operation as recently carried out by Lieberg (17). The latter recommends for such cases the formation of a skin flap adjacent to the defect with its broad base on the side of the abdomen (Fig. 9 and 30). It is then turned up upon the defect according to well known principles of plastic surgery and the wound is closed by suture throughout (Fig. 31).

4. *Rodman's incision* 1903 (20 and 21). Rodman, fearing that the movements of the limb might become restricted in the future by scar formation resulting from the usual

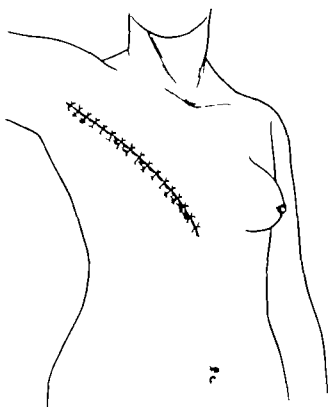


Fig 14 Shirred suture (Diagrammatic)

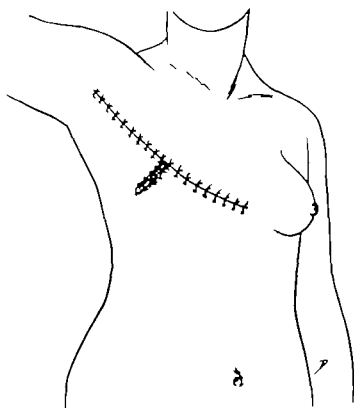


Fig 15 Abundant looper skin flap stitched up in shape of fold in order to equalize cut edges (Diagrammatic)

incision recommends a transverse cut through skin and muscle in front of the axilla thus preserving the external portion of the pectoralis major muscle with its tendon (Fig 32). He then cuts the tendon of the pectoralis minor muscle (Fig 33) and adds the circumcision of the breast and Handley's skin incision downward (Fig 34). He extirpates the deep tissues from the axilla toward the sternum according to Willy Meyer (Fig 35).

Rodman gave much time and study to the question of the radical operation for cancer of the breast and published a valuable book on the subject (20). Unfortunately he was called away from his many friends and admirers before he could complete the second edition of the book.

5 *Stewart's transverse incision* 1915 (22). Stewart's transverse incision appears to be most recommendable in patients in whom the cosmetic result has to be considered viz in whom it is important that the upper portion of the chest should be free from scar formation. The dissection of the deep tissues which follows the radical operation as done by Willy Meyer is as a matter of course in

its technique more difficult than when the usual incision from the humerus down to the linea alba with its direct access is employed.

The accompanying illustrations (Figs 37 to 40) nicely bring out the various steps of Stewart's advance.

#### SPECIAL CONSIDERATIONS

1 *Importance of not invading the infected area for the purpose of diagnosis*. Personally, I greatly fear to enter what I call the infected area and unqualifiedly disapprove of the procedure still often practiced in cases of doubt as to the diagnosis i.e. of cutting down upon and into the tumor to obtain a piece for examination in frozen sections and then add the radical operation if malignancy is proved. In the first place such hasty examination of frozen sections is not reliable or rather cannot be considered final. It has been observed that seriatim cuts done by the pathologist at leisure have proved circumscribed malignancy when the first verdict rendered under high tension, had been in favor of benignancy. I consider this program for an operation for carcinoma absolutely wrong and always





Fig. 18. Skin defect grafted ultimate result showing statue of liberty posture



Fig. 19. Wound closed by sutures throughout. Perfect mobility of arm shown

access to the subclavian vein up to the clavicle

Rodman says in his article and also in his book that Willy Meyer advised the removal of the great pectoral and urged in addition that the lesser pectoral be also removed so as to insure more complete axillary dissection.

Willy Meyer certainly never expressed himself that way. Free access to the axillary cavity was for him only a minor reason for leaving the pectoralis muscles in their normal anatomical relation and remove them in one mass. The main reason was to be able to keep out of the infected area during the entire operative work as far as this is at all feasible.<sup>1</sup> Heidenhain on basis of his careful microscopic studies declared that a locally diseased muscle must be completely excised from its origin to its insertion in order to do justice to the patient.

During that early period of Willy Meyer's breast operations in which he removed the

great pectoral muscle — (or pectoralis major plus minor) — *after* ablation of the breast (six cases) he found in two instances enlarged glands between the two muscles. He therefore considered it a step in the right direction not at any time to work within the spaces *between* the two muscles but to leave this area entirely undisturbed i. e. extirpate both muscles together and entirely. For this reason he also made it a point to lift up the entire mass and clamp the perforating arteries *before* their entrance into the muscles viz. below the undersurface of the same.

Willy Meyer's contention was later on corroborated by Rotter and Grossmann. Rotter believes that in one half of all the cases there are to be found enlarged lymphatic glands between the muscles which cannot be recognized with the pectorales *in situ*. Grossmann succeeded three times in thirty subjects when injecting from the mammary gland the lymph bearing vessels which perforate the great pectoral running between it and



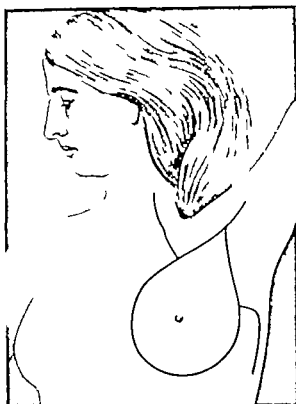


Fig. 1. On the pectoral muscle. (From the article of John C. Warren, *Annals of Surgery*, 1904.)

the pectoralis minor to empty finally into the subclavian or topmost axillary glands. Rodman observed retropectoral enlarged nodes in two cases. Since 1894 I have re-

peatedly seen this occurrence in the course of my work besides the two cases mentioned above.

The objection advanced against total extirpation of the pectoral muscle is thus that it means a mutilation of the patient. I would not concede that total extirpation means a mutilation. True it makes the region beneath the clavicle appear somewhat flatter on the side operated upon than on the opposite side. However in an attempt to cure this disease the cosmetic result should not be a decisive factor. The ultimate functional result of the arm is always splendid. Its movements are free and unimpaired.

I personally favor the complete removal of both pectoral muscles in every instance.

3. *Suprascapular glands.* Whether a radical attack is indicated in the presence of enlarged suprascapular gland was for a time a mooted question. Personally I have never seen a patient survive the operation for any length of time under such conditions. But others have observed it. Halsted reports three favorable cases of this type out of forty operated upon at the Massachusetts General Hospital two patients out of forty with palpable neck involvement operated upon were found well and free from carcinomatous involvement three years after operation and Rodman had one patient who lived four years after the operation and then died of recurrence in the pectoral wound there was no return of the disease above the

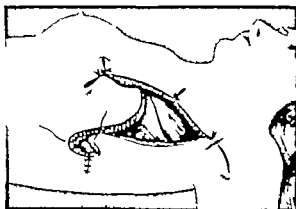


Fig. 2. Flap has been turned in and caught with one suture.



Fig. 3. Final adjustment of the flap. The final sutures are still to be tied.

clavicle. Hence it would seem that palpable neck involvement is not necessarily hopeless and the attempt should be made to bring radical help also in these serious cases.

The removal of the supraclavicular glands does not however seem absolutely called for as a routine measure in every ordinary case of radical operation. Experience has shown that quite a number of patients have remained cured without this addition. In none of the author's thirteen patients that had in 1907 remained well from 5 to 13½ years were the supraclavicular glands removed. However the cleaning out of the supraclavicular space *must be done* whenever the tumor has invaded the two upper quadrants of the breast especially if it involves the skin because the lymphatic vessels of this region enter into the supraclavicular glands across the anterior aspect of the clavicle.

On the whole I consider it best to have during the operation right after completion of the ablation frozen sections made of the last one or two subclavian glands i.e. the glands nearest the clavicle at the lower border of the subclavian vein. I find in

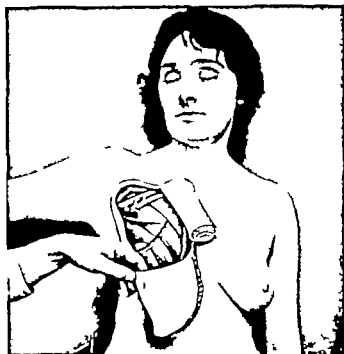


Fig. 4 Skin flap rolled up in a large gauze pad; dissection up under the breast and toward the chest.

perusing the literature that J. Collins Warren has come to the same conclusion. If the last or the next to the last gland shows cancerous infiltration the cleaning



Fig. 23. Jack on a skin incision outlined. [Figs. 23 to 26 taken from the article of I. N. Jackson, *Journal of the American Medical Association* 1906.]



Fig. 25. Quadrilateral flap of skin and superficial fascia stretched out by tenaculum forceps and transferred inward to cover defect created by removal of skin.



Fig. 40. Position to expose

out of the supraclavicular space must be added at the same sitting. This is done most radically by dividing the clavicle temporarily near the spot where the subclavian vein dips beneath it, then removing the gland with surrounding fat of the supraclavicular space contiguous with the subclavian plus axillary mass.

Whether such temporary division of the bone is really indicated the future will have to show. For the present it would seem sufficient to remove the diseased tissue through an additional skin incision. If the operator divides the upper skin flap toward the middle of the clavicle this incision is simply continued upward into the supraclavicular space. The special and separate skin incision in the supraclavicular space may be varied. It must always thoroughly expose the posterior cervical triangle particularly the posterior border of the sternocleidomastoid muscle. I have tried straight curved and flap incision or a combination of both (Fig. 41). The latter incision has appeared to me best (Fig. 41 No. 5). If the cosmetic result plays a role a transverse cut just above and parallel to the clavicle may well suffice. The tissue under the clavicle itself must be thoroughly cleared out in conjunction with

the supraclavicular. It seems best for this purpose to expose the upper border of the subclavian vein from above with the neck rounded forward and the head pushed well back.

4. *X-ray.* A prolonged X-ray treatment should follow every operation. We insist upon this wherever it is financially feasible. In the light of our present knowledge we seem to owe this additional treatment to the patient. Preoperative and early postoperative exposure to the rays of spinal column and femur the places of predilection for metastasis seems advisable (3).

5. *Carcinoma of both breasts.* Cancerous affection of both breasts is no contraindication to the operation. Of three personal cases treated with double amputation two have lived longer than three years without recurrence, one sixteen years after the second operation which was done one year after the first, the other 5 years after the second operation which was done three years after the first.

6. *The virulence of the disease according to age.* Observation has shown that the younger the patient the more virulent is usually the disease.

7. *Cancer of aberrant (supernumerary) mammary gland.* Cancer developing in an

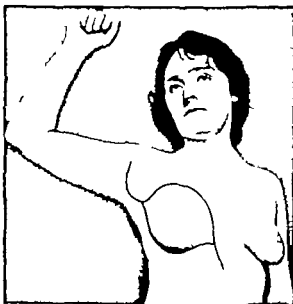


Fig. 41. Handley skin incision. (See Handley 3.)

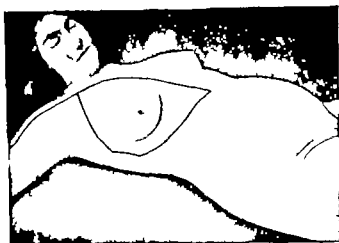


Fig. 28. Skin incision for the removal of the breast and diseased skin in case of far reaching involvement. (Figs 28 to 31. See Elsberg *Annals of Surgery* 1915 Vol 678)

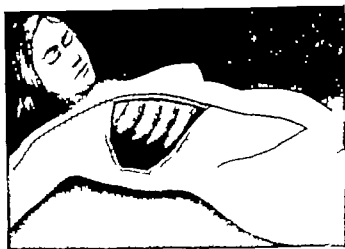


Fig. 29. Part of the wound has been sutured. The abdominal flap is shown in outline.

aberrant or supernumerary breast is some times not recognized and therefore incompletely operated on after which it usually proves extremely virulent. If correctly diagnosed the aberrant tissue is usually found outward and upward in the upper quadrant of the breast or within the axilla — the radical operation including removal of the entire breast should be done.

8 *Chronic multiple cystic mastitis*. Chronic multiple cystic mastitis is often confounded with carcinoma. It usually presents multiple and freely movable nodules in one or both breasts which require extirpation best with the help of Thomas' incision at the fold between the breast and the chest below.

Careful microscopic study of the extirpated nodules is of course necessary. For as stated above the examination of frozen sections made during the operation is not sufficiently reliable to enable us to base thereon the indication for more radical operating. In one of my cases the center of a fibroma on careful serial frozen section examination showed typical carcinoma necessitating immediate radical operation which resulted in a cure. The patient having remained well and free from recurrence twelve years. Parker Syme of New York in a recent lucid article entitled *Chronic Cystic Mastitis or Abnormal Involution of the Breast* (24) considers the trouble a typical precancerous stage and proposes

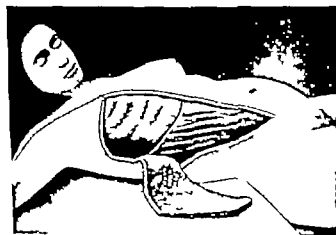


Fig. 30. The abdominal flap of skin and fat has been raised.



Fig. 31. The abdominal flap in its position and the entire wound closed by suture.

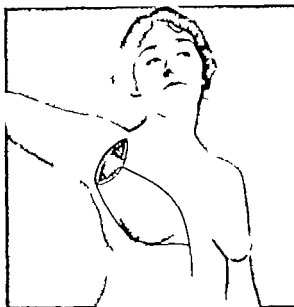


Fig. 13. Dissection of pectoral minor at its insertion.

Fig. 13. Primary dissection of the pectoral minor muscle on the right side. Fig. 14. Dissection of the pectoral minor muscle on the right side.

radical operation in every case. He argues that with this operation done the life of such patients would later on develop carcinoma would surely be saved. He certainly is correct in this contention. Nevertheless there is such a thing as going too far in our anxiety to be on the safe side. The psychic effect of the radical operation should be taken into account in these cases. Personally I would be willing to accept the patient's age as a guide in performing Thomas operation in the younger patients up to say 25 years — obtaining of course a pathologist's report on the specimen — and amputation of the breast without removal of the axillary glands and pectoral muscles in patient above that age up to 3 years and the radical operation in patients more than 35 years. I realize that this division may seem rather arbitrary, however according to my observation Thomas operation suffices in younger individuals with chronic cystic mastitis. None of my cases thus treated has returned for a secondary operation. On the other hand I have had two cases, one 32 the other 44 years of age in whom local extirpation for what seemed to be a cystic fibro adenoma

was insisted upon although I had advised amputation and in both cases a very malignant far advanced carcinoma of the same breast came to operation 8 and 10 years respectively after the first operation. The disease had advanced so far that the prognosis was naturally very bad and both patients succumbed to the trouble. Had the respective breast been amputated at the time of the first operation the carcinoma would undoubtedly not have developed.

9. *Chronic (late) suppurative mastitis.* In this connection the chronic (late) suppurative mastitis deserves mention. The trouble may present the typical picture of carcinoma diffuse hard tumor slow growth infiltrated axillary glands. But there is pain and tenderness on deep palpation. Edema of the skin so rarely found in carcinoma is not infrequently present. The trace of the finger persists after pressure showing that the more superficial glandular tissue is breaking down. The history reveals a preceding period of nursing not infrequently several years (3 to 4) previously. The aspirating needle will usually clear up the diagnosis. Radical operation is of course contraindicated. Incision and drainage suffice.

10. *Bloody discharge from the nipple.* A bloody discharge from the mammary is suspicious of carcinoma but may also occur in benign disease. It is safest to consider it an indication for radical operation.

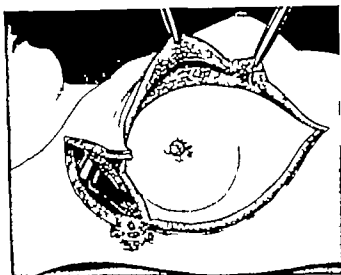


Fig 34 Incision deepened and anterior flap undermined

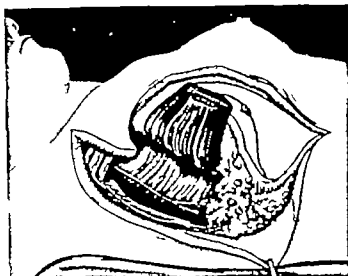


Fig 35 Undermining inferiorly muscles breast and axillary mass being reflected prior to removal

11 *Large single cysts of the breast* Simple tapping of cysts of the breast in patients of cancer age seems inferior to the radical operation. Still Abbe's (25) and Shepherd's (26) many favorable and lasting results from aspiration command attention. Here as in the case of chronic cystic mastitis conservative surgery will in some instances be responsible for the patient's death from carcinoma later on. In other words had the radical removal been done instead of simple aspiration the carcinoma would probably not have been the cause of the patient's death. The trouble is we are unable to tell in what particular case tapping alone will suffice. In older patients it surely appears wiser to do the radical operation. Now and then a breast may be unnecessarily sacrificed. But better far to err in this than in the opposite direction.

12 *Resection of the axillary vein* should unhesitatingly be carried out with the removal of the axillary glands when the latter are too closely attached to its wall to be removed with safety. Care must be taken to preserve the current in the cephalic vein by placing the central ligature on the axillary vein distal to its entrance into the subclavian. The author has one patient under observation who is entirely well today two years and two months after the axillary vein had to be resected for a firmly attached local recurrence.

13 *Combination of tumors* A recurrent endothelioma of the back the original growth having been excised under cocaine by a colleague was found associated with a typical scirrhus of the breast, in one of my patients a male 55 years of age. The breast was radically removed and the endothelioma again cut out. The latter recurred becoming inoperable and caused death two years later while the cancer of the breast remained cured.

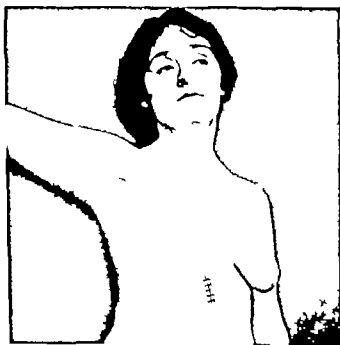
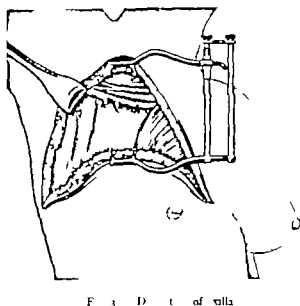
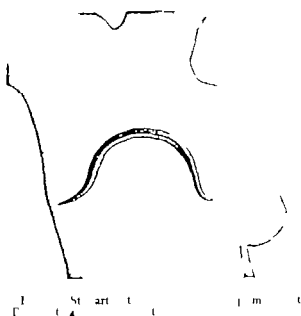


Fig 36 Wound closed (After Guthrie)



It seems worth adding that the patient, a faithful wife who was aided by two nurses, was interruptedly attended to him until the final issue developed: cancer of the upper portion of the trachea for which after local treatment had failed, laryngectomy plus resection of the upper end of the trachea was done by me. No local recurrence developed but intra-abdominal metastases caused death nine months after the last operation.

In this connection I might cite a few other instances observed by me of carcinoma developing in husband and wife. I will just enumerate the cases as far as I recall them without giving details.

Cancer of rectum—cancer of breast the latter attacking the wife shortly before her husband's death. Cancer of breast—radical operation, no local recurrence nor metastases six years later husband succumbs to incur-

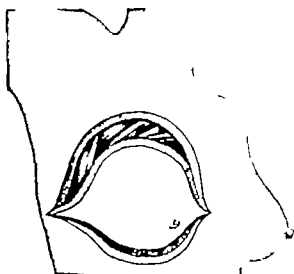


Fig. 39. The lower end of the tumor on which is made after evacuation of the villi.

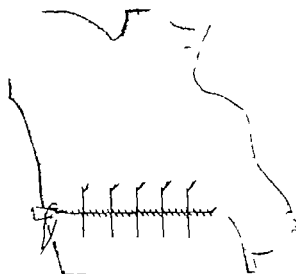


Fig. 40. Incision closed.

able cancer of colon which had slowly grown for a number of years. Cancer of stomach in husband wife later develops cancer of breast. Cancer of bladder and prostate cancer of cervix uteri the latter in spite of hysterectomy took the patient's life before the husband succumbed.

Such observations afford much food for thought.

#### STATISTICS

As regards statistics I almost feel inclined not to give any. There is no real value in personal statistics. The same careful and thorough operation carried out in two patients in identically the same way by the same surgeon may prove a complete cure in one while in the other it may be followed by rapid local and regional recurrence or general metastasis.

That patients afflicted with cancer of the breast *can be cured* by means of the radical operation has been amply proved by surgeons everywhere. However the ultimate fate of these patients is dependent not upon the surgeon's work but determined by the following conditions:

1. The degree of virulence of the original disease (infection?)

2. The duration of the disease before operation.

3. Whether the diseased (infected) area was entered.

The practice of invading this danger zone in doubtful cases in order to obtain a piece of the tumor for frozen sections cannot be too severely condemned as has already been emphasized above.

Still as it is customary to give statistics and as it is perhaps also of interest to see what lasting operative results one individual surgeon has had I will give a brief résumé of my results.

My personal statistics were published in a paper on this subject in 1905 (11) and again in 1907 (27).

The 1905 report covered 67 patients that could be traced out of 70 operated upon. Of these 26 per cent had remained free from recurrence from four to ten years after operation.

The 1907 report comprised 84 cases all of

which were operated upon by the same radical operation done between September 1894 and April 1907. Of these 83 were females, one male. The youngest case was 28 the oldest 72 years old. As four patients could not be traced 80 remained for consideration. Of these 28 or 35 per cent were alive and well at the time of the report. Of 43 patients operated upon between September 1894 and April 1902 viz from 5 to 12½ years before rendering the statistics in 1907 17 or 39.5 per cent remained free from recurrence from 3 to 12½ years after operation or 13 i.e. 30 per cent, from 5 to 12½ years after operation.

These cases as well as those operated upon later were not selected but subjected to operation as they came along. The presence of supraclavicular glands was not considered a contra indication but the clinical possibility of demonstrating metastasis in remote organs was<sup>1</sup>. The author believes it the surgeon's duty to remove whatever can be reached with the knife so long as metastases do not forbid an operation to his mind the surgeon is not only expected to operate when a possible cure is in sight but also when all he can hope for is to alleviate trouble and pain physical as well as mental.

My records show that from September 1894 to September 1916 125 patients submitted to the radical operation at my hands.

Of these four died, one a female 65 years with diabetes of long standing death from coma 48 hours after operation. The family insisted on radical work though warned.

The agent which causes and great tumors not only at first affects the axillary and subclavicular lymphatic glands in certain cases of cancer of the breast, but sometimes enters the general circulation as early as the cancer deposits in distant organs, or locally in the lymphatic system, and bones without producing any local symptoms whatsoever. Of the bones the body of the vertebrae of the spinal column and the long bones of the lower extremities particularly the femur are most frequently affected. It has been argued and gliding so that the liver and lungs with pleura usually become involved directly by way of the lymphatic system but the skeleton metastases can develop by way of emboli only. It is the same process here as in infection by microbes elsewhere. The filter represented by the axillary group of lymphatic glands may prove insufficient. The virus infects the glands but passes through the rest of the group and thence enters the blood. It may also reach the latter through the lymphatics. It has been estimated that 50 per cent of all patients subjected to radical operation for cancer of the breast do not develop local or regional recurrence but metastases in the more distant organs just mentioned which sooner or later closely follow the operation as to leave no doubt that the nucleus for the same was sown before the time of the operation upon the breast. Regarding bone metastases Dr. J. Levin, New York, has by presentation on the part of the patient that cancer metastases in the body of two lumbar vertebrae follow a radical breast operation on had been kept in check by 1½ years for more than a year the patient was able to move around and stop without pain. Dr. Levin therefore wonders the medical profession and demands that it should be ascertained whether or not it should be regarded before operation and even in the face of metastases in these bones the radical operation performed and followed by any treatment thereafter.





One had a fibro adenoma removed 9 years previously at the age of 33 years, radical operation having been urged at the time of the first operation.<sup>1</sup> Three months after the radical operation laparotomy became necessary and showed the presence of double ovarian carcinoma, inoperable.

In one patient the axillary vein was resected at the time of a second operation for local recurrence, two and one half years after the first operation. She is well today two years and one month after the vein resection.<sup>2</sup>

Five of the 68 patients later developed supraclavicular glands and were operated upon. None of these nor those who presented supraclavicular involvement at the time of the breast operation was ultimately cured.

Three patients of the 68 are among the four whose cases were briefly related above as having died after the operation of causes that had no direct bearing on the radical operation as such (diabetic coma, acute sepsis, anaesthesia).

Thirty six patients or 52.94 per cent died within 3.4 years after the operation: 22 from local recurrence plus metastasis, 14 from internal metastasis.

In eight of these patients the disease had so far advanced that had the author selected his cases they would certainly have been excluded from operation.

In conclusion I would repeat what I have stated above. That the radical operation for carcinoma of the breast as practiced today offers a fair prospect of a permanent cure provided the tumor is operated upon at an early stage of its development, when the disease is still localized and has not transgressed the borderlines of the affected organ and the group of regionary lymphatic glands.

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## TRANSPLANTATIONS OF ECTOPIC PREGNANCY FROM FALLOPIAN TUBE TO CAVITY OF UTERUS

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**H**ERLTOFORT<sup>1</sup> it has been the advice of our best men that when ectopic pregnancy was diagnosed during the early quiescent period or when it has been discovered during an abdominal operation it should be removed at once. This has been the rule followed for years. It has been accepted as the only thing to do. Why have we all these many years been so willing to deprive these little children of the right to live just because they were started wrong?

In this day of advanced surgery with the art of transplanting different parts and in fact organs of the body I wonder at the escape of so important a procedure, entailing so little danger as the transplanting of an ectopic pregnancy from the fallopian tube into the uterus, thus permitting the child to develop and be born as was its intention before its progress was obstructed.

Before we go any farther let us look into the conditions and structure of the parts with which we are dealing. The anatomical structure of the fallopian tube is the same as that of the uterus of which it is a continuation—a serous coat, a muscular and mucous coat. The inner or mucous coat is continuous with the lining of the uterus and at its free extremity with the peritoneum.

According to Edgar the pathology of ectopic gestation is in part as follows:

This includes changes in the ovum, *foetus* and *utrus*. The gestation sac is formed from the coats of the tube. The muscular tissue instead of undergoing hypertrophy often tends to disappear.

The attachment of the ovum does not differ from that in normal uterine pregnancy. A placenta forms but the decidua structures are rudimentary so that the chorionic villi penetrate readily into the gestational sac as far as the peritoneum.

If the *foetus* does not die its tendency is toward poor development and the various deformities and diseases noted in intra uterine *foetuses*.

Exceptionally survival occurs and the child may be well developed. The collateral changes in

the *utrus* during ectopic pregnancy are the same to a certain extent as those found in normal pregnancy even the formation of a decidua vera. If the ovum has these changes are arrested otherwise they progress although at a much slower rate than in intra uterine pregnancy. The decidua however does not keep pace with the uterus and are usually thrown off *en masse* simulating abortion. Exceptionally they are retained to term when so-called false labor occurs.

Thus we see that the early gestation in the tube is practically the same as in the uterus with the exception of its chorionic villi which extend deeper or rather through into the muscular wall—due to the thinness of the parts in the tube.

Up to a certain point the tubal gestation is identical with the intra uterine gestation. Up to a certain point the uterus keeps pace with the tubal gestation and actually forms a decidua, enlarges, softens, grows darker in color and in fact takes on all the early features of pregnancy.

It is playing the part of a disappointed hostess. It had expected and was fully prepared to receive the fecundated ovum had it not been delayed. Even then it seems hopeful and continues to develop though slowly and if the ectopic pregnancy goes on to full term the uterus will be seen at that time to be as large as a four months natural pregnancy.

Does it not look possible then for an early tubal pregnancy to be transplanted into the uterus where everything is ready and waiting for it?

Nearly every surgeon who has done any great amount of work has come upon unsuspected cases of ectopic pregnancy while in the abdomen for other purposes. So far as I can learn every one of these has been removed together with the tube without even an attempt having been made to save either. This has been the proper thing to do. Everybody did it. In some cases it is the only thing to do yet. Early diagnosis of ectopic pregnancy is next to impossible.

unless it is accidentally discovered. And until someone finds a way to make a more definite diagnosis it will continue to be the method. However when we do find an early case, where the tube is still in a healthy condition, not too badly distended and all things favorable, I think we should make a supreme attempt to save the life of the growing child by opening the tube carefully and dissecting out the pregnancy intact and transplanting it into the uterus where nature intended it should go. It can be very quickly done. It does not endanger the life of the mother and may be her only chance to bear a child. In support of this theory I wish to report a case which will show without doubt that it can be done.

September 13 1915 Mrs W J W age 27 house wife American of good appearance with dark complexion menstruation regular married five years no children no miscarriages constipated urine normal nervous pulse normal temperature normal. Family history negative. Personal history negative except that she had been told by one physician she had a fibroid in the posterior wall of the uterus. I found this to be true. She was very anxious to have children. Her husband was a fine clean well built man of good habits.

September 15 1915 Operated on for fibroid and when abdomen was opened, we found an ectopic gestation in the left tube at outer part of isthmus. The tube was very soft and healthy enlarged to the size of a walnut but not distended. The uterus showed the same shade of darkening color.

The fibroid was about the size of a large hen's egg and extended into cavity of uterus. On removing the fibroid I was compelled to make a clean cut incision encircling the tumor and into the cavity of the uterus extending down to and involving the inner os. Knowing their anxiety for raising a child I decided to try at least the only thing at hand—to transplant the ectopic pregnancy. I knew it could be easily removed from the cavity of the uterus if it did not grow to the wall and be retained

and nourished to full development. Had it failed to attach itself it could have easily been dislodged by the use of a curette.

However I was not called upon to remove it as all went well. The tumor removed, I left the uterus protected while I carefully opened the tube and dissected the pregnancy out intact, being careful not to injure the sac in any way by keeping wide away and including part of the tube wall. It came out very easily and was in size about equal to a large olive. It was at once placed within the cavity of the opened uterus and caught by two of the sutures of the inner row of plain No. 1 catgut used in closing the wound in the uterus. The tube was closed in like manner and left in place. The patient was watched carefully for any hemorrhage vaginal discharge, or signs of trouble for two weeks with no symptoms whatever.

She left the hospital on the 14th day after a complete recovery. The pregnancy went on normally to full term and resulted in the natural birth of a fine boy fully developed and without a scar. May 2 1916.

No doubt the raw surface of the edges of the wound in the uterus was instrumental in the perfect attachment of the transplant. They gave a good source of blood supply to the raw surface of the detached sac or tube wall thus enabling it to adhere readily.

I have not the least doubt that many such transplanted ectopic pregnancies will be reported in the near future.

We may and will have failures in this as in other transplantation procedures but there is not the danger involved in this transplantation that there is in many of the others. Certainly it is worth the most extreme effort in favorable cases. At this time it is of course difficult to differentiate the favorable case and this matter must be left to the judgment of the surgeon. The condition of the tube and surrounding circumstances such as the stage of development, inflammatory conditions adhesions displacements and wishes of the mother must all be considered.

## THE PRESENT STATUS OF ROENTGEN THERAPY IN THE MANAGEMENT OF DEEP-SEATED MALIGNANCY<sup>1</sup>

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**I**N reviewing the present status of roentgen therapy in the management of deep-seated malignancy first let me say that the subject is hardly one which can be properly considered by itself for in the battle against malignant disease one is not justified in the sole employment of single remedies. Operable malignancies certainly do not furnish the indication for roentgentherapy alone but as a prophylactic against recurrence the application of radiant energy is of great value. In hopeless malignancies we shall do well to avail ourselves of the combined effect of all the anti-cancer agencies at our command whether roentgen rays, radium, surgical excision or heat destruction as the need of the individual case may require.

Further there is such strong similarity between roentgen rays and the  $\gamma$  rays of radium both as to physical properties and biological effects that I shall include here certain considerations of the radium question.

Just at the present time the attitude of the surgical profession seems strongly influenced by a powerful wave of criticism of roentgen rays and radium as therapeutic agents in cancer. Some of this criticism is unkind and unjustifiable the result of failure to distinguish between the claims made by over-enthusiasts and propagandists and the good results demonstrated by the relatively few men who are in a position to know whether the application of the roentgen rays or radium has been carried out with proper technique and adequate dosage.

Much confusion and skepticism have been generated by the extravagant claims of some whose opportunities outstripped their knowledge of the physical laws governing the therapeutic use of radiant energy but on the other hand the records of conservative competent men should command respectful consideration and before pronouncing judgment as to the claims of the radiologists

referring both to roentgen ray and radium therapists one should be sure he understands just what they have shown themselves able to accomplish.

The sincere radiologist aspires to be considered a scientist not a propagandist. He seeks not the success of a particular method for his greatest interest lies in contributing his share in the battle against disease and though he may be disappointed over his failure to do the impossible by curing malignancy already beyond surgical relief there is still the gratifying realization that his labors have relieved pain and lengthened the span of useful life in these unfortunate cases.

In the words of an ancient English surgeon if a panegyric were necessary it were best made by running through the particulars of the art and the history of the diseases relieved thereby. And though failing in absolute cure of malignancy we shall still appreciate the good palliative effects of radiotherapy which are far better than can be obtained for these cases in any other way.

Now what are the claims which in the light of present clinical experience may be advanced for radiotherapy in cancer? Summed up briefly they are as follows:

1. Radiotherapy referring both to roentgen rays and to the  $\gamma$  rays of radium does experimentally destroy cancer cells in laboratory animals.

2. Practically also there is no question about the successful destruction of cancer cells in the human body.

3. This destructive effect is a deep one both for roentgen rays and radium. There is no doubt about the possibility of local cure of malignancy even when deep-seated by exposure to radiant energy.

4. With reference to superficial malignancies no one will contest the statement of Pusey that upward of 90 per cent of such lesions will yield to radiotherapy resulting

in absolute cure. Our entire time will therefore be spent in the discussion of deep seated lesions.

Wickham has fully described the effects of radium and roentgen rays on various normal and pathological tissues stating that there is practically no difference in the histological changes produced by these two agents. Of the pathological tissues he studied epithelioma of the skin, glandular epithelioma and connective tissue tumors.

In an ulcerating epithelioma of the skin after a latent period of fifteen days more or less depending on the dosage the epithelioma cells show an extraordinary hypertrophy of their elements and completely disappear after cornification which is disseminated total and atypical. The horny masses disappear through phagocytosis and cicatrization is completed at the expense of the stroma of the tumor.

In glandular epithelioma the changes are analogous. The neoplastic cells of breast carcinoma for example after going through a sometimes monstrous hypertrophy disappear ending in fusion by cytotoxicity or in absorption by phagocytosis. The hyperplastic stroma penetrates into the lobes of degenerated cells displaces them, envelops them and organizes a smooth elastic scar tissue rich in cells.

In sarcoma at least of the spindle cell type after a latent period much shorter than that in the epithelioma the neoplastic cells show an increased nutritive and proliferative activity which is evidenced by great hypertrophy. The cells then become stellate and are overtaken by death in the midst of their growth and development being absorbed by phagocytes. In a specimen of fibrosarcoma it seemed that at a certain depth the weakened rays did not destroy the neoplastic cells but produced a biological change which gave them the morphological characteristics of a benign fibroma, with final transformation into cicatricial tissue.

These observations of Wickham which agree absolutely with those of Haendly, Dominici, Clunet, Ruelot, Lapointe and numerous others demonstrate that the changes induced in epithelioma and sarcoma by

exposure to roentgen rays and radium show the same mechanism. The cells die in a condition of monstrosity and their disappearance is accomplished by means of phagocytosis. The destructive effect is strictly local being confined to the tissues upon which the rays are directed. There is no distant effect. Carcinomatous tissues are fairly sensitive to irradiation, this sensitiveness being greater than that of the surrounding tissues except in certain locations. Histologically it has been demonstrated that under roentgen or radium exposure degeneration of malignant cells may take place before any effect upon healthy cells is demonstrable. The greater the capacity of a cell for proliferation and regeneration the more sensitive it is to radioactive agents. The nearer the malignant cells approach the embryonal type of tissue the greater their radio susceptibility. The younger pathological cells are affected by rays which have passed through healthy tissues without producing destructive changes.

The latent period in sarcoma is shorter and the predegenerative hypertrophy of the sarcoma cells is much more active. Certain sarcomata are not destroyed by the rays but are simply converted into benign fibrous tumors and from these into cicatricial tissue. Good effects are more often observed in round and spindle cell sarcomata than in tumors with very much differentiated cells. Pfahler has apparently demonstrated that it is possible to heal certain osteosarcomata the healing process being characterized by a progressive deposit of lime salts in the tumor areas until the tumor area attains the solidity and density of normal bone.

All the cells and tissues irradiated are influenced by the rays but to a very variable extent. This is well illustrated in a case of advanced pavement epithelial carcinoma of the cervix reported by von Franke in which operative removal occurred the day after the last irradiation. The epithelium of the uterine glands in the immediate neighborhood of destroyed malignant foci was unchanged while the connective tissue seemed to be undergoing active proliferation. In some places the connective tissue looked like young granulation tissue and contained abundant





Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 2 Radiogram of a watch made by exposure for fifteen hours to fifty milligrams of unfiltered radium element at a distance of fifteen inches.

Fig. 3 Roentgenogram of the same watch exposed to six milliamperes (Coolidge tube backing up a ten inch spark gap) for 7 seconds at a distance of fifteen inches, no filter.

Fig. 4 Roentgenogram of watch at fifteen inches target plate distance (Coolidge tube backing up a ten inch spark

gap) fifty milliamperes eight second filter two millimeter of bry.

Fig. 5 Radiogram of same watch made by exposure for fourteen minutes to fifty milligrams of radium element four centimeters distance no filter. Compare with Fig. 6.

Fig. 6 Roentgenogram made in one twentieth of a second fifty milliamperes of current and a focus plate distance of eleven centimeters. No filter. Compare with Fig. 5.

ative as was the roentgen method sixteen or eighteen years ago.

Some simple experiments may serve to render more vivid the statements just made concerning the intensity and penetrating power of the roentgen rays. When a gold watch is placed upon a photographic plate and exposed alternately to a hard roentgen tube and to fifty or a hundred milligrams of radium element it will be found that fifty milligrams of unfiltered radium element at a distance of fifteen inches from the plate require fifteen hours to make a satisfactory radiogram of the watch (Fig. 2) whereas the passage of six milliamperes of current in amount ordinarily used in treatment work through a Coolidge tube at a focus plate distance of fifteen inches gives a very distinct roentgenogram showing the internal works of the watch with surprising detail (Fig. 3) with an exposure of only six seconds.

When the radium is enveloped in a gold tube such as has been employed for deepest therapy twenty hours are necessary to accomplish what fifty milligrams of radium element what fifty milliamperes of current will do in eight seconds when filtered through two millimeters of bry. (Fig. 4) the distance from the plate remaining fifteen inches in both instances.

When the fifty milligram tube of radium element is brought as near as four centimeters to the plate which is less than the distance from the skin to the interior of most malignant tumors it still requires fourteen minutes (Fig. 5) to produce the same change on the

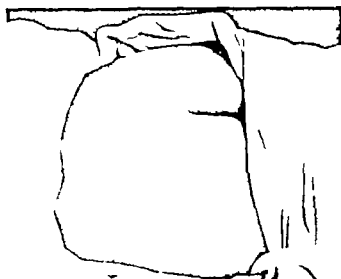


Fig. 7 Photograph illustrating the tanning of the treated areas as a result of multiple roentgen radiation through filters in the course of deep therapy for a pelvic malignancy. Note that the discoloration of the skin is uniform indicating that nearly the same dosage of X rays was given throughout all of the area. This photograph demonstrates the accuracy with which it is possible to administer X-ray treatment.







Fig. 12. A case of Hodgkin's disease referred by Dr. Joseph L. Miller. Before treatment.

radium rays both of which have a high degree of penetration and intensity of biologic effect and furthermore that this destruction may be brought about in the deep tissues of the body providing the therapist commands the necessary skill and experience in their application.

Why then are cures so infrequent?

In the first place the treatment is usually inadequate. There are in this country literally hundreds of roentgen equipments presided over by men and women not prepared by education or experience to use them.

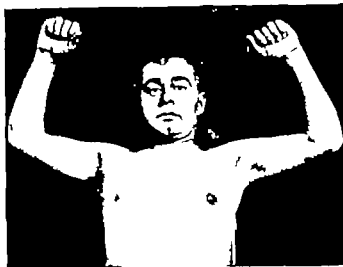


Fig. 13. The same case as in Fig. 12 after three months of deep roentgentherapy. The treatment was continued for seven months.

Very often the one in charge is not even a physician. Even though a physician it does not follow that being given charge of a roentgen installation he is endowed with the necessary knowledge and experience to use it. And even the physician trained in diagnostic roentgen work may be woefully deficient in the therapeutic application of the ray.

In the second place the destructive effect of the rays is purely local at least so far as cancer is concerned. We have no proof of a



Fig. 14. Roentgenogram of the chest in the case of Hodgkin's disease which a mile before treatment was taken and at the same time a Figure 15. Note the marked mediastinal enlargement as well as the tracheal narrowing which is due to pressure of the enlarged cervical gland.

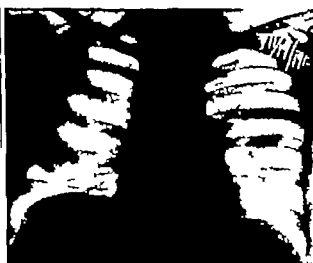


Fig. 15. Roentgenogram of the chest of the case of Hodgkin's disease taken seventeen months after Fig. 14 and more than a year after Fig. 13. The patient later developed an asthenic state, died about two and a half years after the beginning of treatment. The glands did not enlarge again.





Fig. 18 (at left) Carcinoma of the esophagus at the level of the aortic arch. Note the barium residue and the irregular filling defect. A gastrostomy was done. Later a silk thread was swallowed the lower end being hooked out of the stomach through the gastrostomy opening.

Fig. 19 Same as figure 18. A capsule containing fifty milligrams of radium element in a proper metallic filter surrounded by rubber was attached to the upper end of the



thread and by traction on the lower end drawn into the tumor area (at arrow). X-ray treatment was also applied from the surface. This case illustrates well the method of combining roentgen and radium therapy. Although the patient within two months was able to swallow solid food comfortably, he later committed suicide because the surgeon (very properly) refused to close the gastrostomy opening.

but even in these cases the patient usually enjoys a new lease of life; he is able to resume some or all of the duties pertaining to his station, and the development of complications is postponed.

The literature abounds in reliable reports of cases of inoperable and hopeless malignancies where such results have been secured. Hours would be required for the recital of the brief abstracts I have prepared from nearly three hundred articles upon this subject which have been published within the last three years. I am appending to this article a few illustrations of some of the striking results which we have obtained. Some of our most convincing cases are of deep seated lesions which are not amenable to photographic demonstration. There is no doubt that in a considerable percentage of inoperable and recurrent malignant disease the patient may be restored to subjective health and a period of usefulness, and the fatal end postponed so that in many instances final relief comes through some quicker, more merciful, intermittent affection. Even should the patient

succumb to recurrent malignancy, its progress when it does appear is speedy and much less distressing than death by the primary lesion.

Unless the future should make the absolute cure of malignancy possible by means of ray treatment for which our present sum of experience does not warrant any very vigorous hope, we must strictly adhere to the rule that neither radium nor the roentgen rays should replace or interfere with the surgical treatment of cancer. All operable cases should be submitted to surgical treatment, but this treatment should invariably be followed by systematic and adequate roentgen or radium therapy or both. This treatment should be instituted as soon as possible after the operation and applied as thoroughly as though we believed the disease still present in its entirety, the patient's sole prospect of cure depending upon the efficiency of our work. Not only should we treat the site of the original disease, but all the related areas in which recurrence is likely to occur. I have also for some years advocated pre-operative treatment whenever practicable, the pre-surgical application being

administered a week or ten days before the date set for operation.

In the treatment of inoperable malignancy, recurrent or metastatic lesions, every efficient means at our command should be employed—a combination of methods. Surgery by the knife or heat destruction may take away masses of disease and combined radiotherapy, radium internally and roentgen ray externally, will tend to destroy outlying foci or at least retard their development.

The profession as a whole does not seem to appreciate the importance of palliative treatment in the case of cancer patients. A certain element of fatalism is seen in the attitude of many toward helpless cancer patients more than is noted in their dealing with other classes of incurables. What is needed is that the public should become sufficiently educated in the matter so that they will understand the necessity of submitting themselves early enough to radical surgical treatment. But these lesions are so often painless and symptomless in their early stages that even the medical profession itself is not yet sufficiently educated as to the imperative necessity of early diagnosis of malignancy. And the tragedy of it all is that for a long time to come we shall continue to see advanced cases of inoperable and hopelessly malignant disease which might have been cured or mitigated in their earlier stages. It behooves us therefore to endeavor in every possible way the

development of radiotherapy and through friendly and constructive criticism to lend our influence to the maintenance of the highest standards in our work and the attainment of the highest ideal.

#### SUMMARY

I do not believe in submitting operable malignancies to radiotherapy in place of surgery.

The use of the roentgen ray and radium at least for the present should be restricted to pre and post operative irradiation and to the treatment of inoperable malignancies.

Radiotherapy does destroy cancer cells. The destruction can be brought about without serious injury to the neighboring normal tissues. The destructive effect is a deep one both for radium and the roentgen rays. The roentgen ray have a much greater intensity and penetration than is usually appreciated. The ideal method is to employ a combination of radium and roentgentherapy in all cases of tumor affecting cavities of the body.

There is no question about the possibility of effecting a local cure of cancer in the human body. We leave our patient in the end because of inaccessible metastase. But in the way of palliation of suffering, prolongation of useful life and in a few unexpected cases clinical cure lasting a decade or longer there is no other known therapeutic agency that can equal the results of radiotherapy.

## THE PRESENT STATUS OF ROENTGENOLOGY IN THE MANAGEMENT OF DEEP SEATED MALIGNANCY

BY GEORGE I. FAMILI, M.D. 1129

**I** THOROUGHLY agree with all the observations made by Dr. Cline in his very excellent and comprehensive paper. Time will not permit a thorough discussion of all points brought out, but I desire to emphasize especially three things.

1. Every operable case of carcinoma should be operated upon either surgically or by electrocoagulation and such operation should

always be followed by thorough postoperative deep roentgentherapy. Based upon results that I have seen and upon the theoretical and experimental results obtained by the roentgen rays, I believe that it is of advantage to give ante operative treatment a week to ten days preceding the operation. The raying should be as thorough as possible without damaging the skin. Such treatment however should

not delay operation. The operation might better be done first and then followed by active and thorough postoperative treatment. At any rate even though there be a preliminary course of roentgentherapy the operation should be followed by postoperative treatment.

2. Every case of malignancy operated upon should be followed by thorough postoperative treatment. This should be given as soon after the operation as is practical so far as handling the patient is concerned. Generally this can be given within a period of two weeks and it is my practice to repeat such a course of postoperative treatment once a month for three to five months depending upon the degree of malignancy. By such thorough postoperative treatment I believe that the surgical results can be doubled.

3. Every inoperable or recurrent case of malignant disease should be subjected to thorough deep roentgentherapy for it has been demonstrated that extensive and recurrent malignant disease can be made to dis-

appear completely and can be made to heal even though it be deep and metastasis has taken place to bones. I have had undoubted cases of sarcoma in which the disease has disappeared and the patients have remained well from 6 to 14 years even though recurrent. I have also had cases of metastatic carcinoma of bone which have been made to heal. I believe however that these patients in whom the disease has extended to the bones will never completely recover but will ultimately die of the disease because while the disease may heal in the area that is being treated it is likely to develop in other parts of the body for one must expect a general carcinomatous to be present when the bones are involved. Despite this fact however I know of patients whose lives have been prolonged at least three years with disappearance of all local and recurrent disease. The results obtained in recurrent and inoperable cases are such as have never been equaled by any other means of treatment and until something better is discovered it is our duty to give these patients the benefit of this treatment.

## HERNIA THROUGH THE TRIANGLE OF PETIT

By JOHN H. RISHMILLER, M.D., F.A.C.S., MINNEAPOLIS, MINNESOTA  
 Surgeon, Swedish and I. Hoopitals

TWO sides of Petit's triangle are formed by the anterior bundles of the latissimus dorsi and the posterior fibers of the external oblique and its base by the crest of the ilium. The thin tendinous fibers of the internal oblique are attached to the intermediate space of the crest of the ilium which forms the floor of this triangle. In some subjects the fibers of the latissimus dorsi are attached farther backward or the external oblique is attached farther forward on the iliac crest therefore the size of Petit's triangle varies accordingly. The part of the latissimus dorsi forming the posterior border of this triangle is densely tendinous in individuals whose musculature is well developed (Fig. 1).

Hernia through Petit's triangle is almost always congenital. It is sometimes acquired but rarely traumatic. Little is known as to the cause of lumbar hernia or hernia through Petit's triangle as only four cases have been operated upon which have been reported, my case making the fifth consequently the defective anatomic relations have escaped careful study. In my case the defect which permitted the hernial protrusion was a weakened condition of the internal oblique muscle which closes the floor of this triangle and it is likely that in congenital lumbar hernias a frayed out and ill developed muscle may be the cause as it is in the inguinal variety.

Owen closed the wound with catgut. Kuster closed the defect with a skin muscle bone flap.

## STERILITY IN THE FEMALE

B. MARK T. COLDSTINE, M.D., F.A.C.S., CHICAGO

It is my purpose to present briefly my personal experience in the study of sterility in the female. For a working basis female women may well be divided into two groups:

1. The class in which the pathology is so great that it is at once apparent to the examiner that the woman cannot become pregnant. For instance in the presence of large pus tube, tubal varium abscesses and large fibroids the class in which operation have been performed removing the tubes and both ovaries and the uterus. Although we must of course remember the extrahinary cause of child birth under the most unassuming condition the cases of abnormal development in which it is apparent that there is an abnormal union of the ovum and spermata and these cases in which are found various causes of dysarcumia preventing normal uterus.

Those cases in which the factors causing sterility are of an obscure nature and which require careful study. Into this second group can be put the cases of salpingitis with non-palpable tubes, ovaritis with enlargement of the ovaries, changes in the uterine mucosa, immaturely developed uterus, acute ante flexion, partial stenosis of cervix, hange vaginal, cervical and uterine secretion, one pregnancy sterility conditions out of the female generative organs such as syphilis, gonorrhea and the wasting diseases, obesity and physconia. In the first group sterility is one of many symptoms in the pathology of the female organs and in the second is one of possibly two or three others and can be the only one in an apparently healthy woman and in fact the only symptoms in both wife and husband.

Except in those cases in which careful examination shows that it is impossible for a woman to become pregnant, a competent and thorough examination of the husband should be made to learn whether or not he is responsible for the childless marriage. Since such examinations are being carefully made

we find that the number of cases of sterility to be treated is diminishing. Taking the average from the statistics of various authors we find that about 50 per cent of the childless marriages are due to the husband's inability to produce live spermatozoa.

By many gonorrhea is thought to be the most frequent cause of sterility in the female. While it is a prominent factor it has never impressed me as so important as many authors would lead us to believe. If the husband were able to deposit healthy live spermatozoa in the vagina the gonorrhea which the man has or has had would not prevent the wife from becoming pregnant. The history of a gonorrheal infection in a husband does not necessarily signify that the childless marriage is due to the infection being transmitted to the wife. Gonorrhea may be present in the female generative organs and escape detection though the examination be thorough, nevertheless one should be cautious in making a diagnosis in a husband his treatment entirely on history.

In case of gonorrheal infection in which the husband has a discharge and the wife is under treatment for sterility I have on two occasions used in conjunction with other treatment an autogenous vaccine made from the husband's discharge and injected into the vaccine the wife with good results. How much good it does or what will be the ultimate value I cannot say but it seemed to me worth trying. I have done this in 9 cases. In my practice the uterus itself has been most often the seat of the difficulty. The immaturely developed uterus with partial stenosis of the cervical canal and this sometimes associated with a retroflexion or acute ante flexion is often found. The two latter conditions can hold with an apparently normal sized uterus and cervix. The above class of cases has yielded the best results where treated by a dilatation of the cervix and the insertion of a silver stem pessary to be retained in the cervix by suture and allowed

to remain for a period of time — two to three months — to insure a permanent relaxation. By acting as a foreign body it causes uterine contractions and an enlargement of the body of the uterus. Should the tube be forced out it can be reinserted until such time has elapsed as to insure a permanent result.

This method is preferable to the cutting operations on the cervix for it does more toward correcting the trouble and is far simpler. In overanxious recently married people who come for treatment in the first 6 to 12 months of married life it is well to delay as the female organs sometimes develop under the influence of sexual intercourse and the desired result is obtained. Too hasty operative interference in sterility cases should be advised against. Such procedures should be used only as the last resort. I have never felt justified in advising an exploratory laparotomy in cases in which examination has revealed no pathology and all methods of treatment have failed.

The changes in the vaginal, cervical and uterine secretions which have a detrimental effect on the spermatozoa can be overcome by proper medicinal treatment and if one could study the spermatozoa deposited in the vagina after the manner suggested by Max Hühner he could determine the particular part of the generative tract in which the secretion is at fault and where the secretions are normal. If the spermatozoa can be traced alive into the uterine body it is reasonable to suppose that the cause of the sterility is to be found either in the tubes or ovaries.

Such procedures are rather difficult and tedious and the material rather limited owing to the lack of interest on the part of these patients who expect rather superficial treatment to accomplish the result.

In studying sterility cases the effect of goitre, obesity, alcohol, lack of sexual enjoyment, too frequent indulgence in sexual intercourse in producing sterility has never been clear and where the above conditions have been tentatively assigned as a cause it has been done because the treatment failed and not because the diagnosis could positively be made. Where a woman has suffered from a severe exophthalmic goiter before marriage,

or first pregnancy it may be a factor in producing sterility of the absolute type though the female organs are healthy.

Appendicitis undoubtedly plays an important part in causing sterility as we know it is often the cause of severe infection of the right tube and ovary and affects the left appendage with more or less uterine and pelvic infection. With an apparently healthy generative tract and a history or objective signs of chronic appendicitis one can advise operation with some degree of hope of curing the sterility for the appendix could cause a non detectable mild pelvic inflammation which would clear up with the cause removed.

The one pregnancy sterilities have been to me very unsatisfactory cases to handle and have given very poor results particularly in those cases in which an induced abortion had been performed early in married life. The element of infection enters largely into these cases and the difficulty most likely lies in the ovaries rather than the tubes as puerperal infection is more apt to attack the former. In those cases in which sterility follows a first pregnancy that has caused an overdistention of the uterus we find a very small uterus of the undeveloped type usually with a history of a marked diminution in the menstrual flow without any history of infection. These cases are very resistant to treatment and I have yet to obtain results in a single case. It is a question whether or not such sterility could not be due in a measure to prolonged steady pressure of the large uterus on the ovaries pressing them against some other structure.

The husband should be examined in one pregnancy cases the same as in the absolute sterility. This brings up the question of how often a sterile husband should be examined to ascertain if it is possible for him to regenerate.

Apparently normal individuals may live together as husband and wife for many years without producing offspring and then for some unknown reason the wife becomes pregnant. Marriage may be entirely barren, the parties separate marry others and both have children.

The tendency of today is toward small families. What effect this attitude may have



on sterility is an open question. I have never seen it happen that any one of my patients who no matter how hard her mind was set against conceiving was able in this way to prevent pregnancy.

Sterility is a many-sided problem and is worthy of careful study and analysis and it

is difficult to draw conclusion though some methods of treatment have given results. It is a question in instances in which we have diagnosed a case to our satisfaction how long after a given treatment if pregnancy supervenes may we claim our diagnosis was correct and our treatment successful.

## STERILITY IN THE MALE

By LOUIS E. SCHMIDT, M.D., F.A.C.S., CHICAGO

WITHOUT discussing minutely the question of sterility in the female I will take up some of the phases so that the question of sterility in the male may be more fully understood.

There are constantly coming to us wife or husband or both with the complaint of a childless marriage and it behooves us all to work for a satisfactory solution of this important problem.

It has been frequently noted that men who previous to marriage have been examined by competent physicians and pronounced fit after they have taken the marriage vows have found in due course of time their inability to have children. The certificates of health oftentimes demanded for eugenic marriages are in these cases worthless in so far as they designate the procreative powers of the couple. Before marriage the semen should in some manner be obtained for examination. Never should one advise intercourse but rather masturbation. However occasionally the wearing of a condom in case of nocturnal pollution will permit of the examination.

Again in childless marriages the husband with a guilty conscience as regards a previous gonorrhea with or without complications or with an admission of having had both epididymes and testes swollen or with a history of a syphilitic infection will consult his medical adviser.

Whenever the question of sterility is considered, either in the married or the candidate for marriage it is my custom to elicit a careful

history. Unquestionably the venereal portion of the history should be noted as regards the character of infection whether or not complicated the character and extent of treatment the number of infections and naturally the time besides when the last gonococcus was found how long before marriage and whether or not the wife commenced to have urinary or menstrual disturbances soon after marriage whether or not the patient has had mumps or other infectious disease which occasionally involve these organs as well as whether or not tuberculous processes exist elsewhere in the individual, and also whether or not there have been injuries which might have played a role.

There is no method of estimating the functional activity of the testes except that the examination of the semen permits of the examination for spermatozoa whether normal in size shape motility and number. This normal state must be the index. Naturally the absence or presence of either or both normal or pathological elements must also be considered.

To correctly understand the question a knowledge of the normal appearance of semen must be understood. It is out of the question for me to go into this detail.

In married women Huebner proposed in 1913 a new method in the diagnosis and treatment of sterility based upon the finding of spermatozoa in the female genitals. It simply consists of the examination of the secretion obtained at various intervals after coitus from the vagina cervix or even from

the body of the uterus. As I am only considering the question of sterility in the male it is practically needless for me to state that if normal appearing spermatozoa with motility can be found in the mucus of the vagina or cervix there can be no doubt about the potency of the male. However if the spermatozoa are non motile in the mucus taken from the vagina it is desirable to examine the contents of a condom. Whenever this is done the semen should be kept by one method or another at body temperature until examination. The shorter the period elapsing until examination the more certain the findings. Naturally this holds true no matter how the semen is obtained whether by masturbation or otherwise.

If no child is born within the first two years of marriage and no methods of prevention of conception used, one must assume that there is fault either with the male, female or both. This is what brings the woman to the physician. If semen obtained in the vagina shows motile normal spermatozoa there is no need to examine the male, even if the wife states that most of the semen is lost at the time of ejaculation or immediately following.

At the present status of our knowledge whenever the question of childless marriages arises the male should always be considered the offender and should be the first examined.

In the examination of the male after taking the history and making a thorough physical examination chiefly medical and neurological as well as an examination of the genitalia seeking particularly abnormalities and defects the patient is instructed to bring semen in the manner mentioned. Naturally the usual urinary and blood examinations as well as the Wassermann and gonorrheal complement tests should be made.

Examination of the semen consists of the microscopical, macroscopical or physical and often also the chemical examination.

At some later date, instrumental examination of the urethra, as well as careful rectal and bimanual examination should be carried out. Naturally the external genitalia should be closely inspected and palpated for evidences of disease or malformations.

If the semen shows an absence of sperma-

tozoa or a marked decrease in the number or large numbers and normal in appearance yet partially or completely motionless or distorted spermatozoa, then the male may possibly be regarded as the cause of the sterility. Where there is a complete and constant absence of spermatozoa and testicular elements but the semen is otherwise normal in appearance the condition is probably obstructive in character and certainly the male is then the cause of the sterility. In my opinion this type, if obstruction is permanent, can oftentimes be successfully treated in a surgical manner.

It is not necessary to describe here the chemical or the microscopical contents of semen in the consideration of sterility. In cases where only amyloid bodies are found it might be suspected that the sterility is caused by an obstructive type. Personally I do not believe this to be true. It is my belief that the absence of spermatozoa in these cases is due to some inhibitory control based on theories which I will mention later.

As to the semen which contains deformed decreased numbers or even non motile spermatozoa this certainly belongs to the non obstructive type. All those cases in which there are chiefly only leucithin or amyloid bodies I believe also belong to the non obstructive type. But where only leucithin is present and it comes from the testes it is my opinion that the trouble is based on conditions similar to those found in cases with amyloid semen. The latter of course is derived from the prostate but changes in the testicle may be present at the same time. In cases with semen showing practically only leucithin or amyloid bodies I consider hopeless as regards results from any known treatment whether operative or non operative.

Now after all has been said and done what is the real cause, etiology and the pathology of sterility in the male?

On theoretical scientific grounds and from clinical observation cases of sterility may be divided, for convenience into two classes.

- 1 Cases in which there is an absence of spermatozoa

- 2 Cases in which spermatozoa are present but in which they are either non motile

deformed or show signs of change and also those in which the number is insufficient.

In Class 1 why are the spermatozoa absent? The spermatozoa may be absent due to an obstruction. By this is meant that spermatozoa are produced in the testes but are not found in the semen on account of some type of obstruction located between the testes and the outlet of the ejaculatory ducts. Or the spermatozoa may be absent due to certain inhibitory actions and when either leucithin or amyloid bodies are the chief constituents of the semen.

It must be admitted that there exist special centers probably localized in the cerebral cortex which preside over the functions and the trophic innervation of the male genital organs and particularly over the complicated processes of spermatogenesis. Ceni has demonstrated that prolonged cerebral excitation without producing nerve lesions will stop spermatogenesis and if excitation is kept up sufficiently long atrophic testicular changes will occur.

I have seen many individuals which I am firmly convinced belong to this class. It is well known that the formation of spermatozoa by the testes is not absolutely necessary for the health of the individual. Many cases of known absence of spermatozoa in which examination of the testes has shown an absence of spermatozoa have demonstrated this fact. If Ceni's explanation is not sufficient for all cases it must be admitted that certain influences such as the X rays affect spermatogenesis without influencing the general health or altering the sexual powers.

For this reason simply because a male has sexual power he must not be regarded as potent the semen should always be examined before the wife is even suspected as being the cause of sterility.

There has been a tendency of late to place considerable weight on the pathological conditions of the ductless glands to account for certain disorders referred to as neuroses. Today there is a considerable positive evidence (Hager, Nussbaum, Bayliss, Starling and Loewy) showing the existence of internal secretions from the sexual glands. The forces which produce these secretions undoubtedly

also have a favorable action on the internal secretions inclusive of the spermatozoa. Therefore conditions which influence this internal secretion may be in some instances the dominating factor in this type of sterility where there is an absence of spermatozoa in the semen.

To the best of my knowledge there has been no positive evidence of the isolation of inhibitory secretion or of the cause of this control of internal secretion hence there is no known method to influence the production of spermatozoa in this type of sterility. It has been suggested that there is a correlation between testis and growth particularly growth of bone, hair, blood formation, pigmentation, thymus, thyroid, suprarenal and hypophysis. Even on these grounds many fantastic theories have been formed but from my limited knowledge and experience I have had no results in the treatment of this type of sterility with remedies obtained from these ductless glands.

Rehlfleish carried out experiments and showed that pure testicular secretion has no fertilizing properties. As long ago as Fuerbringer activities it was believed that it was necessary to have the fluids of the prostate, Cowper's glands and seminal vesicles to give spermatozoa the power to fertilize. Supposedly a chemotactic action of any one or all of these fluids was considered necessary. This can hardly be true as in most spermatoceles the spermatozoa are active. As to whether or not they could fertilize an ovum I do not know. If it were true then I espouse vasectomy would be of no value. He has however demonstrated that fluids from the above glands are not necessary.

Vaederlein as recently as 1912 recommended artificial fecundation in cases of sterility where complete examination of the man and the woman give no information. In these cases it may be functional disturbance in woman.

It is undoubtedly true from what has already been stated that absence of spermatozoa in the semen does not necessarily mean obstruction somewhere in the tract.

In cases of sterility which are distinctly due to obstruction operative treatment has been advised and undoubtedly has been effective.

in a certain number of cases. My operative records cover seventeen cases. In only one instance am I positive of results. However in three others I am certain of having found spermatozoa in three to six months after operation. They were only a few in number and not normal in appearance. I will not detail the operative procedures as they are well known to all. I wish to add however that Lespinasse's anastomosis operation in my opinion is more accurate than the others and is the operation of choice for these cases of obstruction in which the obstruction is not too high in the cord.

I have had no experience with Lespinasse's sac operation and personally have never attempted nor even advised artificial fecundation with the help of this operation or where the semen has not been ejaculated into the vagina in cases in which due to some malformation or other causes normal intercourse might be prevented.

There is one other operation which I wish to refer to. It has been devised by A. Strauss for a certain class of cases. As the doctor is here I will not discuss the merits but simply will state that I would not recommend the operation except under the most unusual conditions.

As to the cases belonging to the non-obstructive type that is, those in which there is an action inhibitory to the formation of sper-

matozoa—not the type in which the semen is chiefly composed of leucithin or amyloid bodies and yet in which there are no spermatozoa—the treatment offers some hope. Wherever evidences of any general or nervous disease exists it is needless to say that these conditions demand attention and with the proper guidance oftentimes over long periods of time satisfactory results have been noted.

Now as to the cases in which spermatozoa are present it can be stated that the changes in number and character may be caused by either general or local diseases. Cases with general diseases such as anæmias, syphilis and tuberculosis and cases in which are found other conditions must be treated in the regular manner.

Whenever local disease of the genital organs most often produced by gonorrhœa is present treatment should be instituted to correct it. Whether or not in cases of necrostermia disease of the prostate and seminal vesicles is present causing this condition it demands attention. I might state that in the most pronounced inflammatory diseases of vesicles and prostate I have noted motile spermatozoa in normal numbers.

It is not necessary to go into further detail regarding treatment, I believe I have pointed out in a practical way the causes and remedies as well as given the prognosis in the various types of sterility.

## STERILITY IN THE MALE<sup>1</sup>

By VICTOR D. LESPINASSE, M.D., F.A.C.S., CHICAGO

IN the study of sterility abnormalities in the spermatozoon itself have interested me a great deal and I have tried to elucidate them working from the type of case where the woman is normal and the man is apparently normal, having no history of disease or a history of only a mild disease with no sequelæ. This is a very common type of sterility and one finds in studying such cases that in many instances the spermatozoa are not what they should be, thus fixing

the cause of the sterility in the male. At first glance, the spermatozoa may seem to be normal in motility but if the conditions under which they are prepared are standardized one will discover an enormous difference in the motility of spermatozoa from different individuals. I have found that varying conditions of bodily vigor of an individual will effect a marked difference in the speed and persistence of motion of his spermatozoa.

In solving the problem the time of inter-

course is noted the semen is brought to the office either in a vacuum bottle or in a small package kept close to the body and is then placed in an incubator or vessel of water at 37 C. while in the office. When the slide is ready it is put under a microscope equipped with a warm stage so that body heat may be maintained throughout the time of examination. The best objective to use is the one sixth. To determine the speed of spermatozoa we proceed as follows:

Looking through the microscope we note one of the most rapidly moving spermatozoa the assistant ready with watch in hand we indicate the time of arrival of this spermatozoon at the center of the field by the word start we follow the spermatozoon until it disappears from the field indicating the exact time of disappearance by the word finish the number of seconds elapsing between the two words being the time taken for the spermatozoon to traverse one half the diameter of the one sixth field. When this has been determined for ten or fifteen spermatozoa we obtain thereby the average speed of the spermatozoa at that particular time. We repeat this procedure every hour until motility has ceased. Normal spermatozoa examined an hour to an hour and a half after intercourse will cross the one sixth microscopic field in 5 to 7 seconds. At the second hour the average speed 10 to 12 seconds, third hour 15 to 18 seconds, fourth hour about 20 seconds and fifth hour 25 seconds. With each succeeding hour one will note a marked increase in the number of spermatozoa that have become motionless and a gradual change takes place in the character of the motility. At first the spermatozoa have a rapid direct forward motion as time passes the speed decreases and the motion becomes undulating finally progressive movement ceases and the sperm simply wave to and fro.

Under proper thermal conditions normal spermatozoa will live about 6 hours.

In the routine examination of spermatozoa from sterility cases kept under conditions as described above it is surprising to find the number of cases where the spermatozoa live but an hour or two hence we must conclude

that these spermatozoa are deficient in some way and consequently are the cause of the sterility.

Morphologically the spermatozoa that live but a short time comparatively show a large percentage of deformity particularly the wry neck type.

#### TREATMENT

In considering the treatment of cases of weak spermatozoa we should try to improve the process of spermatogenesis. It has seemed to me from certain experimental data that anterior lobe of the pituitary might favorably influence spermatogenesis. In one case I have had marked success with this gland as shown by the increase in number and the change in the morphology of the spermatozoa. In another case the effect on the spermatozoa was not very marked but pregnancy has taken place by means of direct uterine insemination. In addition to this treatment it occurred to me that this type of sterility case was especially suitable for direct uterine insemination.

It is well known that artificial insemination has been done with some success but not with much thought as to the classification of the type of case in which it should be used. It seemed to me that if weak spermatozoa could be placed at once in a media which was favorable to their life and at the same time very much nearer the ova impregnation would be more likely to follow than if such spermatozoa were placed in the vagina where conditions were not favorable to their life. We started treating this type of sterility by direct uterine insemination and we have one baby born and two pregnancies. Direct uterine insemination requires a very careful technique and attention to many details first it requires a bacteriologically sterile semen or one as nearly sterile as possible this is obtained by thoroughly washing the penis with soap and hot water directly before intercourse. The condom should be boiled before use. All the instruments concerned in the operation should be boiled. The inseminating tube should be inserted from one and one-half to two inches into the cervix and from 5 to 10 drops of the semen injected if more than this amount is injected a uterine colic results.

The insemination is best done either just before or just after the menses. A second indication for direct uterine insemination is cervical disease or distortion of the cervical canal. Here artificial insemination will be as effective as a successful operation. I have had one case of this type and succeeded in obtaining a pregnancy on the second insemination.

#### ENVIRONMENT

Spermatozoa are very susceptible to their environment. Artificial mediators of all kinds are unsatisfactory; the spermatozoa dying very quickly in them. In purulent diseases of the prostate and vesicles the pus is mixed with the semen, and usually this pus destroys the life of the spermatozoa; it is surprising, however, how much pus may be present in the semen at times and the spermatozoa still remain active and impregnate. In this connection I can cite a case in which the woman had an acute infection of the cervix with profuse discharge and the man had an infected prostate with an abundance of pus in his semen; nevertheless while this cervical infection was at its height pregnancy occurred and a normal baby was delivered.

I would also like to mention here some work of mine that has reference to cellular antibodies. You may be familiar with the first production of antibodies to cells by Metchnikoff who used spermatozoa by intraperitoneal injection and in this way produced the first antibody to a body cell. He then went further and produced an antispermatic serum thus laying the foundation for the Wassermann reaction and all the other complement fixation tests and so the spermatozoa in this way is father to the Wassermann reaction. It seems to me that this antibody formation might occur in some of our sterile women. I have seen one woman whose blood serum stops motion in the sperm within just a few minutes. Other blood sera will have no effect upon spermatozoa. So it may be in

some cases in which the etiology is obscure that the sterility is due to some such condition.

Spermatozoa has been demonstrated to live for eight days in the upper female sexual tract; hence this destructive serum would have a long time in which to act, and as a consequence a serum too weak to kill spermatozoa *in vitro* might be sufficiently strong to kill them *in vivo*.

#### OBSTRUCTIVE STERILITY

Obstructive sterility is a type in which there is no question of diagnosis. In examination of the semen we find no spermatozoa present. This condition may be brought about by a closure of some part of the tubule between the testicle and the urethra or it may be due to an absence of spermatogenesis. The only way to differentiate these conditions is to operate upon the individual and by injecting colored salt solution determine the patency or occlusion of the vas and ejaculatory duct. If the occlusion is in the ejaculatory duct or pelvic vas the only thing to do is the *arc* operation. If the obstruction is in the scrotal vas we must perform a resection and union of the vas at the point of obstruction. If the obstruction is in the epididymis it is necessary to make an anastomosis between the vas and the epididymis above the point of obstruction.

#### CONCLUSION

1. Examine the semen of all sterility cases with much care, particularly where any operative treatment of the wife is contemplated.
2. Weak spermatozoa cases should be treated by hygienic measures and direct uterine insemination.
3. All cases that show absence of spermatozoa in the semen should be subjected to appropriate operation to relieve the obstruction.

## TUBERCULOSIS OF THE SPINE—END-RESULTS OF OPERATIVE TREATMENT

BY M. S. HENDERSON, M.D., RICHMOND, MINNESOTA

SINCE 1912 as a result of the original work of Albee (1) and Hibbs (2) the attention of the medical profession and to a large extent that of the laity has been directed to the operative treatment of tuberculosis of the spine. Sufficient time has now elapsed to warrant a review of these methods of treatment and it is with this object that I here report the condition of 81 patients so treated. In this connection it may not be out of place to mention the object of these two methods, their essential differences and what we may reasonably expect of such procedures.

The Hibbs and Albee methods are similar in that each has as its object the establishment of a bony splint on the posterior surface of the diseased vertebra, thus preventing motion which is both painful and detrimental to healing. That this is possible by either method has been amply shown by Hibbs and Albee and other writers. Hibbs prefers to secure the fixation by an ectoplastic operation on the spinous processes and the lamina of the vertebrae while Albee advocates the use of a transplant taken from the patient's own tibia and placed in a trough chiseled in the spinous processes and interspinous ligaments. Inasmuch as the two methods are so nearly alike in their basic principles their relative merits will not be discussed. Figures 1 and 2 show the essential differences of the two methods. Both methods require an accurate and careful technique with perfect asepsis. If these are not provided the operation in a great majority of cases will be a failure. Finally the most important of all it must be remembered that neither method is in any sense of the word a radical procedure. The location of the disease surrounded as it is by most important structures forbids the performance of a radical operation such as may be carried out for tuberculosis of the knee joint. The purpose of the Hibbs and Albee operation is to place

a bony living brace to the spine and thus shorten the period of recumbency and brace wearing.

The proper selection of cases is essential. Debilitated patients and those in whom the disease is hopelessly advanced should not be subjected to operation. This type of patients should be observed and attempts made to increase their resistance by careful conservative method. If these patients do not respond to resting the spine by recumbency it is not at all probable that they will respond to operative procedures. Conditions of the lungs should be carefully ascertained by physical examination and corroborated by the roentgen ray before operation on the spine. Since patient with tuberculosis of the spine associated with pulmonary tuberculosis can not justly be subjected to the same risk as for example those with tuberculosis of the knee associated with pulmonary tuberculosis. In tuberculosis of the knee something approaching a complete extirpation of the diseased area can be performed while in tuberculosis of the spine this is not possible. Accordingly tuberculosis of the lungs must be proved healed or quiescent before the patient is subjected to an operative procedure.

For some unknown reason transplantation of bone is not so uniformly successful in children as it is in adults. By repeated x-ray examinations of the spine following transplantation of bone in children we have seen the graft gradually absorb so that there is no trace of it at the end of a year. The same observation also applies to osteoplastic operations. By this I do not mean to say that children should not be operated on but that because of the reasons stated the question of operation should be weighed very carefully. Only 7 of the patients in the series of cases reported were under 12 years of age. Children can be very easily controlled on a Bradford or Thomas frame and even when operation is performed rest on one of these frames

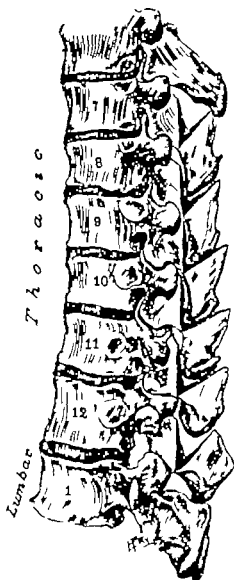


Fig 1 Hibbs operation Fracturing the spinous processes at their bases

should be insisted on until the disease is known to be quiescent

We see adult patients with tuberculosis of the spine who have had considerable destruction of bone with resulting abscesses and sinuses but in whom the skiagram shows there has been a coincident vigorous bone repair. Clinically such patients are not benefited by either of the operations under discussion for they already have what the operation is intended to produce namely ankylosis

The diagnosis in tuberculosis of the spine is usually made too late not infrequently when the patient himself calls the attention of the physician to the lump in the back. To get the most out of the Hibbs and Albee operations the patient should be operated on be-

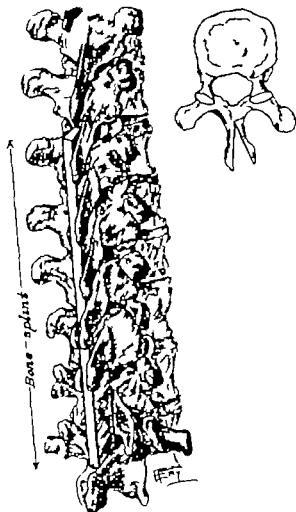


Fig 2 Albee operation Transplant placed in split spinous processes

fore deformity appears or at least before the deformity has reached any considerable size. When it is possible to place the graft in the spine without fracturing or bending it, the patient has a much better chance than when it is necessary to fracture the graft in order to accommodate it to the kyphos. It is somewhat difficult to fit the straight graft to the kyphos and even when skillfully done such fitting is certain to weaken the graft. Usually the bone must be fractured in order to accommodate it to the curve and there is always the chance that union of the fracture may not take place. Figures 3 and 4 show two methods I have used to overcome this difficulty. Figure 3 shows a V shaped osteotomy performed at about one third or one fourth of the distance from each end of the graft. It is planned that the base of this V osteotomy shall be in the medullary portion and the apex of the V carried almost through



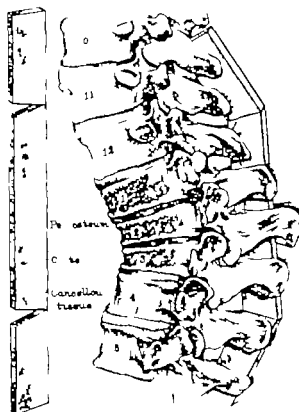


Fig. 3 Method of fracturing graft to take up

the cortex. The graft is then gently fractured at each osteotomy point so that each break will be practically a green stick fracture. The periosteum being intact prevents any separation of the fragments. Thus it is possible to accommodate the graft to the contour of the kyphos. The third method (Fig. 4) is to be used for patients having a pronounced kyphos and consists of sawing the graft which is usually about 7 inches long into three pieces and dividing each piece longitudinally. These can be placed in the trough so that the ends of the short pieces are held in side to side apposition. Union will occur and a strong graft result.

Paraplegia due to the disease does not seem to be a contraindication to operation. I have had no occasion to operate on such a case but good results following operations have been reported by others.

Our duty to our patients is not finished after the operation is completed. They must be kept recumbent until the bone trans-

## TUBERCULOSIS OF THE SPINE

(JULY 92-JULY 96)

Cases observed	274
Cases operated	8
Cases reported	73
Sex	
Male	51
Female	30
Age	
Average	5
Oldest	53
Youngest	
Location	
Dorsal	36
Lumbar	34
Dorsolumbar	1
Cured	4 4 per cent
Relieved	4 8 per cent
Operated	7 per cent
Alive	14 years
Deaths	
Percentage cured of the	( ) per cent

plant is firmly adherent to the spinous processes or the osteal flaps are united. Rest on a gravity frame or stiff bed for at least a month is essential and I am lately inclined to lengthen this period varying it somewhat according to the demand of the individual case. A well fitting back brace should be provided for the ambulatory period and patients should be instructed to wear the brace for one year after all active signs of disease have disappeared. They should live under the hygienic surroundings and have the tonic and sustaining treatment that are prescribed for patients with tuberculosis of the lungs. This treatment is controlled to a very great extent by the social status of the individual and unfortunately can be carried out often only to a limited extent.

In the Mayo Clinic from July 1901 to July 1916 74 cases of tuberculosis of the spine have been observed. Eighty one cases were operated on 74 according to the method of Albee and 7 according to the method of Hibbs. Fifty one of the patients were males and 30 females. The average age was 5 years the oldest patient being 53 and the youngest 2. Only seven were under 12 years of age. The disease was located in the lumbar region in 34 instances in the dorsal in 36 and in the dorsolumbar in 11. The average duration of symptoms was 3 years and 6 months. There were no deaths due to the operation. Seven of the series are known to have died some

time after the operation. These deaths will be discussed later. Three cases are too recent to report upon except to say that the operative convalescence has been uneventful. Five cannot be traced. Seventy-three cases therefore are the basis of our percentages.

The exact time at which patients who have suffered from tuberculosis of the spine are cured is difficult to state even when we have them actually under observation. It is still more difficult to decide when the only means we have of judging is by letter. I have classified as cured those patients who say they have none of the pain they suffered before operation, who are able to go about without spinal support and who have again taken their places in the every day life of normal people. Our patients have been routinely advised to seek light occupations. This of course is not always possible and not a few of them are now doing hard work as the only means by which they can procure a livelihood.

Thirty-one patients (42.4 per cent) are cured. Some of them were able to return to work in 6 months, others not for 3 years, but the average returned between 1 year and 1 year and 6 months. Thirty-three patients (45.2 per cent) are classified as relieved though no doubt some of this group will go on to a cure when sufficient time has elapsed. Although there were no operative deaths, 7 of the 73 patients (9.5 per cent) are known to have died later, 2 of these had been cured of the tuberculosis of the spine. One was a young man aged 23 who had had a Hibbs operation, aspiration of a huge psoas abscess and injection with 10 per cent iodoform emulsion. Following this treatment he gained 40 pounds, was apparently well and resumed hard manual labor for one year. After a severe cold he had a persistent cough and died within 3 months of acute military tuberculosis of the lungs. The other was a married woman aged 32 who made a perfect recovery following operation, only to die three years later of pulmonary tuberculosis. Four of the remaining 5 patients who died later of diffuse tuberculosis should not have been operated on, and in the light of our experience today would not be subjected to surgery. All of

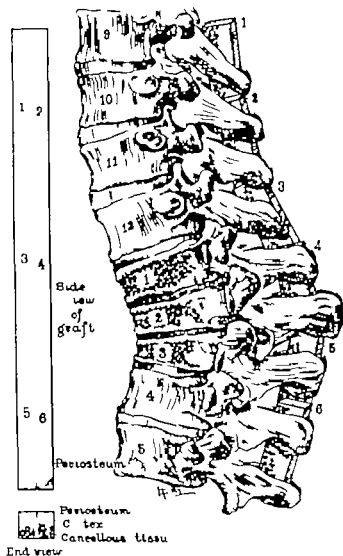


Fig. 4. Method of accommodating graft to kyphosis.

these had draining abscesses with secondary infection, tuberculosis of the lungs in a quiescent stage and were not in good general condition. In one case the graft was infected, the patient was not relieved and died about 3 years after operation of causes unknown. Two patients (2.7 per cent) are not at all benefited by the operation though still alive. These also were in advanced stages and probably should not have been submitted to surgery.

#### CONCLUSIONS

1. Neither the Hibbs nor the Albee type of operation for ankylosing the diseased area in tuberculosis of the spine is in any sense a radical operation for extirpation of the focus of disease.

2 Patients submitted to these procedures should be in good general condition. Paraplegia *per se* is not a contraindication.

3 Children are easily controlled on a gas pipe frame and should be operated on only after careful consideration. The recumbent treatment should be carried out after operation until a cure is attained. In adults after operation and recumbency for at least four weeks a suitable brace should be provided to lie down until symptoms are entirely absent.

4 These procedures in themselves are not serious. A proper selection of patients will give a high percentage of cure and considerably shorten the period of treatment.

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## CARCINOMATOUS OVARIAN TERATOMA WITH PREMATURE PUBERTY AND PRECOCIOUS SOMATIC DEVELOPMENT

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THE case of carcinomatous ovarian teratoma reported herewith is of special interest for the following reasons:

1 Malignant ovarian teratomata including all solid teratomata are rare (see articles of Hicks and Fargett, Frank and Savare with collected cases) and those showing carcinomatous or sarcomatous areas are fewer in number.

2 No other case reported as ovarian teratoma has been associated with precocious sexual and somatic development, although Fusino reports premature menstruation in a patient with a solid ovarian teratoma and Ashkinazy has collected four cases of ovarian sarcoma believing them to be cases of embryonal teratoma in which there were in all cases genital hemorrhages, three times growth of pubic hair, twice mammary hypertrophy and twice abnormal height.

3 The patient was younger than any of the published cases of ovarian teratoma excepting three (see appended tabulation of cases of malignant ovarian teratoma in girls fourteen years old and younger).

4 The growth of the tumor was associated with the beginning of puberty at five years of age and with rapid bodily development (see table of comparison with anthropometric standards).

5 The tumor was a complex cysto-solid teratoma with definite adenocarcinomatous areas (see pathological report and microphotographs).

6 There has been no menstruation since the removal of the tumor and no further precocious growth.

7 There was no discoverable recurrence when the patient was examined thirty months after removal of the tumor a much longer time than the average freedom from recurrence.

The patient, B. R., a girl age five years and ten months, Case 90, 98, was first seen and examined April, 1904. A clinical diagnosis of sarcoma of the right ovary was made and removal of the tumor was performed.

**Familial history.** The family history presents three cases of carcinoma which may possibly bear some relation to the occurrence of malignant tumor in the patient although the cases were remote. A maternal great grandmother died of cancer of the stomach, a maternal great aunt died of cancer of the breast and a paternal great grandmother died of cancer of the uterus.

**Personal history.** The patient weighed six pounds when she was born May 23, 1908 and grew at a normal rate until the age of four years. She was healthy, lived in the country, played like other children, had a cheerful disposition and was mentally bright. Shortly before her fifth birthday she fell from an express wagon and sustained a sprain of the left elbow. The accident deserves mention al-

TABLE I—AVERAGE MEASUREMENTS IN INCHES OF GIRLS FIVE TO NINE YEARS OF AGE (SEEVER)

Age	Number of Observations	Height	Span of Arms	Breadth of Chest	Breadth of Waist	Depth of Chest	Chest Expansion
5 years	83	45	48	7.00	6.55	4.8	40
6 years	35	48	4	7.00	6.40	4.90	30
7 years	84	45.7	44	7.5	6.55	4.95	83
8 years	53	47.3	46	7.45	6.75	4.95	00
9 years	114	49.7	48.5	7.60	6.95	5.1	20

CORRESPONDING MEASUREMENTS OF PATIENT FOR COMPARISON

5 years months		49.8	48	8.90	7.40	5.50	
6 years 10 months		42.8	40	8.60	7.00	5.60	
7 years 4 months		50.1	5	8.90	7.00	4.90	1

OTHER MEASUREMENTS OF PATIENT

Age	Length		Breadth		Depth Abdomen	Girth							
	Sternal	Sternal to Pubis	Shoulders	Hips		Neck	Upper Chest	Lower Chest	Waist	Thigh	Calf	Arm	Forearm
5 years months	4.5		9	8.8	5.6		5	8	5.5	3	7.8	7	6.5
6 years months	5	3		8.7	5		11.5	20	9.5	13.5	9	7	7
7 years 4 months	5	4	3	9	4.8	6	11.5		9.5	5		6.7	6.7

Before and after operation

though there was apparently no abdominal injury which might be related to the growth of the ovarian tumor and the premature onset of puberty.

The first menstrual period appeared June 4, 1913, when the patient was five years old. The second period began August 20, 1913, and was followed at regular intervals of four weeks by five other menstrual periods the last being in January, 1914. Each period lasted one week and was accompanied by profuse menstrual flow and by pain in the lower abdomen. No vaginal discharge occurred in the intervals. There was fever of slight degree during the first two periods. In February and March, 1914, there was abdominal pain, loss of appetite and disturbed sleep but no menstrual flow at the expected time.

The physical changes usually observed at puberty began to be noticed soon after the first menstrual period. The breasts grew larger, the areolae darkened, the pubic region became covered with dark brown hair, hair appeared in the axillae and the whole body developed rapidly (Figs. 1 and 2).

The growth of the ovarian tumor was well advanced by the time of the third menstrual period seven months before operation when its presence was discovered by the family physician. An inverted pear-shaped mass was then palpable slightly to the right of the median line of the lower abdomen. The examination was made on account of symptoms suggestive of appendicitis. The presence of the tumor apparently was not considered sufficiently important at that time to demand surgical consultation. As the tumor gradually increased in size it caused

a corresponding enlargement of the abdomen. Bodily movements such as those involved in buttoning the shoes became difficult to perform and caused discomfort. The patient no longer cared to play and was more and more inclined to sit about and to rest with the head on a table or other support. She complained of being nauseated and her appetite became capricious. Her bowels moved regularly except during the menstrual periods when enemas were found necessary. During the last week before the removal of the tumor the patient slept only two or three hours at a time with intervals of wakefulness when she groaned and seemed to be in pain.

**Somatic precocity.** There were no abnormal findings in the case except the signs of puberty, the precocious somatic development and the physical changes caused by the comparatively large size of the ovarian tumor. The bodily development was symmetrical and the disproportion between size and age was best appreciated by comparison with other children of the same age.

Reference to the standards determined by Bowditch in an examination of 24,500 children attending school in or near Boston shows that the patient at five years and ten months was actually larger than the average girl nine years of age. She was 49.8 inches tall and weighed 58 pounds while the average girl of nine is 49.39 inches tall and weighs 37.07 pounds inclusive of clothing. Seaver gives the average height as 49.7 inches and the average net weight as 54.9 pounds for a girl of nine.

The precocious development of the patient was also shown by numerous physical measurements

TABLE II—TABULATION OF CASES OF SOLID OR CYSTO SOLID OVARIAN TERATOMATA

Author	Age	Present	Present	History	Operation	Pathology	Outcome
Finkelstein				Abdominal tumor palpable	Left tumor removed	Complete tumor	Not recorded
Doneshue	200			Abdominal tumor	Left tumor removed	Complete tumor with metastases	Unfavorable
Unger	20			Abdominal tumor	Abdominal tumor removed	Complete tumor, golden brown pigment	Death five months later
Hick and T. G.				Abdominal tumor	Abdominal tumor removed	Complete tumor, metastases	Death two months later
F. G.				Abdominal tumor	Left tumor removed	Complete tumor	Operative recovery
W.				Abdominal tumor	Left tumor removed	Complete tumor	Operative recovery
K. K.				Abdominal tumor	Left tumor removed	Complete tumor	Operative recovery
B. G.				Abdominal tumor	Left tumor removed	Complete tumor	Well 7 years later
L.	4 yrs		No	Abdominal tumor	Left tumor removed	Complete tumor	No history
F. K.				Abdominal tumor	Left tumor removed	Complete tumor	Death a few weeks after
F. A.				Abdominal tumor	Left tumor removed	Complete tumor	Death 8 months
W. A.				Abdominal tumor	Left tumor removed	Complete tumor	Operative recovery
R. A.				Abdominal tumor	Left tumor removed	Complete tumor	Operative recovery
W. A.	7 yrs		No	Abdominal tumor	Left tumor removed	Complete tumor	No history
B. A.				Abdominal tumor	Left tumor removed	Complete tumor	Well 8 months later
G. A.				Abdominal tumor	Left tumor removed	Complete tumor	Well 7 months later
S. G.	14 yrs		Had tumor removed	Abdominal tumor	Left tumor removed	Complete tumor	Death 1955
H. G.	7		Had tumor removed	Abdominal tumor	Left tumor removed	Complete tumor	Death 7 months later
S. G.	14 yrs			Abdominal tumor	Left tumor removed	Complete tumor	Recovery
S. G.	14 yrs		No history	Abdominal tumor	Left tumor removed	Complete tumor	Recovery
K. G.	years			Abdominal tumor	Left tumor removed	Complete tumor	Operative recovery

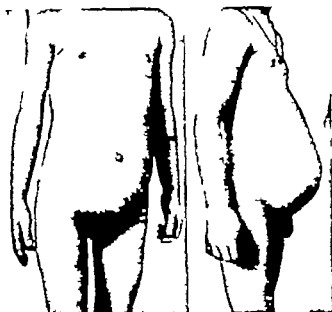


Fig. 1 Photograph of the patient front view showing development of breasts and areolar abdominal enlargement and growth of hair in pubic region

Fig. Photograph of the patient side view showing noticeable development of breasts marked abdominal enlargement and growth of hair in pubic region

which have been tabulated for comparison with normal standards as determined by Seaver (Table I).

**Physical examination** Sight hearing taste and smell were normal. All of the milk teeth were present and in excellent condition. There was no enlargement of the thyroid gland nor of the lymphatic glands of the neck axilla or groin. The heart and lungs were normal. The spleen was normal in size and position. The liver was normal in size but was somewhat displaced by the tumor of the right ovary.

On palpation of the abdomen the tumor mass was found to be nearly globular elastic in its left half and apparently solid in its right half. By its large size it tensely distended the abdomen and reached one inch above the umbilicus. It lay principally in the right half of the abdomen but could be moved about to a limited degree. Except in the region immediately over the tumor the abdominal wall could be easily depressed by the palpating hand. No abnormal masses other than the tumor were palpable in the abdomen. Percussion over the abdomen gave a dull note in the area corresponding to the tumor but there was no dullness in the flanks to indicate ascites.

On bimanual examination the uterus was found drawn well up in the pelvis by the tumor the cervix lying three inches from the vaginal orifice. The uterus was normal in size shape and consistence and could be moved independently of the tumor. The left uterine appendages were normal.

A roentgenographic examination of the abdomen was made by Dr. James F. Case with reference to the identity of the tumor. The outline of the mass



Fig. 3 Roentgenogram showing outline and density of the tumor malignant teratoma of right ovary

and the densities found in the roentgenograms corresponded to those of an ovarian or uterine tumor and from a study of the roentgenograms and fluoroscopic observation of the characteristic displacement of the air distended colon Doctor Case gave his opinion that the tumor was a right ovarian cyst of the multilocular type (Fig. 3).

**Laboratory examinations** Examination of the blood made April 1, 1914, showed 82 per cent hæmoglobin 4,050,000 red blood cells per cubic millimeter and 25,800 white blood cells per cubic millimeter.

Examination was made of a specimen of urine 200 cubic centimeters in amount. The specific gravity was 1.029 total solids 13.51 grams urea 6.00 grams chlorides estimated as sodium chloride 1.40 grams indican 2 per cent (Folin scale) no albumin and no sugar. There were no microscopic findings except a few pus cells in each field.

**Surgical operation** During the preparation for operation the patient developed nausea and vomiting pain and tenderness in the right side of the abdomen and a rise of temperature to 103 F with a pulse rate of 130. In view of the history of a previous attack of appendicitis and the existence of a leucocytosis of 25,800 white blood cells per cubic millimeter it was decided to remove the appendix with the ovarian tumor. It was recognized that the symptoms might be due to changes in the ovarian tumor with absorption of toxic substances.

A laparotomy was performed April 2, 1914, through an incision one half inch to the right of the median line of the abdomen extending upward from the pubes to a point two inches above the umbilicus.



photographing the bones lying on a plate beside a ruler. Figure 7 was made from a roentgenogram of the bones arranged on an X ray plate.

**Microscopic examination of the tumor.** The pathological study of the tumor was made by Dr. A. S. Wirtun, to whom the writer is indebted for the following complete pathological report and for the microphotographic illustrations (Figs 8 to 14).

The growth shows areas of fetal cartilage in association with unstriated muscle lymph nodes mucous glands and ciliated columnar epithelium representing anlage of the respiratory system—bronchi. One area presents the appearance of fetal lung tissue definite alveoli with vascularized walls respiratory epithelium bronchus like structures giving an appearance precisely like that of embryonic lung. Dermoid cysts containing hairs sebaceous glands and sweat glands also occur in the mass. Neuroglia tissue and nerve cells are found in association with ectodermal structures. Intestinal tissue resembling that of the gastro intestinal tract is also present. These portions of the neoplasm present structures arising from all three germ layers ectodermal mesodermal and endodermal. The tumor is therefore a complex teratoma. The larger part of the growth however presents the appearance of adenocarcinoma in some places showing solid medullary masses of carcinoma. Areas of necrosis are found in these medullary masses and the histological appearance of these areas is that of a well developed adenocarcinoma. The tumor is therefore a malignant teratoma with carcinomatous transformation. If no secondaries are found in the peritoneum the prognosis is good. The tumor does not appear to have broken through the capsule.

**Subsequent history.** The patient was examined twelve eighteen and thirty months after operation. She had been well except for an attack of whooping cough in June and July 1915 and had completely recovered her former physical vigor. Her bowels were regular. She had a good appetite was sleeping well and was attending school.

There had been no menstruation since the removal of the tumor and no vaginal discharge. The pigmentation of the areolae had returned to normal and the breasts were no longer prominent. The pubic hair had grown scarcely any since the operation and the slight new growth was in marked contrast to the former heavy growth of dark brown hair.

There were no abnormal masses palpable in the abdomen. The operation scar was firmly healed. Bimanual examination discovered no evidence of metastasis nor of recurrence of the tumor in the broad ligament.

Roentgenographic examination of the lungs made September 30 1915 showed no evidence of pulmonary metastasis. There were a few enlarged glands about the lung root and some peribronchial thickenings radiating upward into the apex on each side undoubtedly due to the recent whooping cough.

The patient had grown at a normal rate since the removal of the tumor. (See Fig. 15 for appearance



Fig. 8 (upper left) Microphotograph teratoid area suggesting fetal lung structure.

Fig. 9 Microphotograph teratoid area with ciliated columnar epithelium and mucous glands.

Fig. 10 (lower left) Microphotograph teratoid area with islands of cartilage.

Fig. 11 Microphotograph edge of dermoid cyst.

of patient one year after operation.) The patient's net weight was fifty nine pounds twenty three months and thirty months after operation.

An examination of the blood made February 18 1915 showed 85 per cent of hemoglobin 4,250,000 red cells per cubic millimeter and 14,200 white cells per cubic millimeter. An examination of the blood made September 30 1915 showed 76 per cent of hemoglobin 4,350,000 red cells per cubic millimeter and 11,600 white cells per cubic millimeter.

Differential counts of leucocytes showed the following percentages of the entire count for each variety:

	Id	8	0	5	9	10	0	5
Small lymphocytes	27	5						8
Large lymphocytes	3	0						3
Transitional forms	3	0						2
Poly morphonuclear								
philes	63	5						63
Eosinophils	3	0						1
Pathological elements	0	0						0

Examinations of the urine February 18 October 1 1915 and October 16 1916 showed no abnormal findings.





Fig. 1. Photomicrograph of a section of a teratoma.

The patient resembled the majority of the reported cases of malignant ovarian teratoma in the following points:

1. There was history of abdominal enlargement associated with pain and fever.
2. The tumor was large, pedunculated and free from adhesions.
3. The tumor was simple in structure and contained many small cysts.
4. There was evidence of peritoneal fluid.

Stewart states that amenorrhea is a characteristic symptom in malignant ovarian teratoma. In this patient after seven menstrual periods there was no flow at the expected time of two periods preceding the removal of the tumor.

Varying colors have been reported in the pigmentation of these tumors—gray (Sjovall), rose color (Tapie and Meriel), bluish red (Pick), brownish red (Rabinowitsch), brownish yellow (Frankl), golden brown (Dudgeon) and black (Hicks and Turgett).

The hair contained in these tumors has been noted in a number of cases to be the same in color as that of the patient. In a Japanese patient the hair in the tumor was long stiff and black (Iwasse). In one case hair of two varieties was observed in the tumor—short fine blond hair and longer black hair like that of the patient (Franco).

The probable cause of the phenomena of precocity in this case was the action of hormone-like substances produced in the ovarian teratoma. Embryonal teratoma has been compared to pseudogestation and Askanazy believes that the production of precocity is not

a function of the organ affected by the tumor but a function of the tumor itself or of embryonic tumor tissue although only certain embryonic tissue will produce precocity. He reports that teratoid tumors of the ovary, testis, kidney, adrenal, lung and pineal gland have all been observed to produce precocity.

Wurthum and Chabrun (quoted by Fwing) have each reported cases of malignant testicular teratoma associated with the secretion of colostrum (lactation) in the male breast and Wurthum states that lactation has been observed in the female breast in association with malignant ovarian teratoma, indicating some hormone action between these tumors and the secondary sexual apparatus. Starling has caused lactation to occur in non-pregnant animals by the injection of fetal extracts.

#### PROGNOSIS

The histories of the reported cases of malignant ovarian teratoma are so uniformly bad in their final outcome that one is not justified in making an optimistic prognosis even after the expiration of thirty months without discoverable recurrence. In the history of the case, the existence of the tumor for more than seven months before removal, the large size of the tumor, the complexity of its structure and the numerous areas showing carcinomatous change are prognostically unfavorable. On the other hand there was no peritoneal metastasis and no apparent involvement of other organs at the time of operation; the tumor was not adherent and

there were no papillomatous outgrowths from it and the tumor was not tapped but was removed intact through an adequate abdominal incision which obviated manipulation of the tumor

With reference to the almost uniform history of recurrence and death in cases of ovarian teratoma the writer wishes to emphasize the fact that tapping of these tumors rupture of the wall in freeing adhesions and removal of the tumor piecemeal all favor prompt recurrence This is shown by cases of Pick Hicks and Targett Franco Dudgeon Falco and Rabinowitsch On the other hand Savare reports a case in which the patient was well twenty-one months after operation although the tumor broke in the separation of adhesions Sjovall reports a case of ovarian teratoma in which recurrence and death occurred in two years and nine months after complete removal of the uterus and adnexæ the tumor recurring in the vaginal scar

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Fig 15. Photograph of patient side view made one year after operation showing abdominal scar and return of breasts to normal

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# DEPARTMENT OF TECHNIQUE

## OPERATIVE TREATMENT OF PLS CAVUS

STRENGTH TRAINING

B. ARTHUR STINDLER, M.D., F.A.C.S., CHICAGO

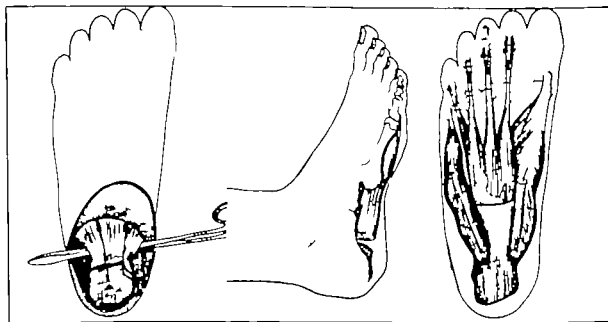
**D**ISAPPOINTMENT in the usual method for the relief of the cavity deformity by the resection of the plantar fascia has led me to look for a more radical procedure which would offer a better relaxation of the tissue on the plantar and a better guarantee against recurrence of the deformity. A short on-plantar heel that the muscle mechanism leading to this deformity rest upon the full weight of the foot. The deformity in paralytic cases is the expression of a disturbed balance with a surplus power in favor of those muscles which shorten and heighten the longitudinal arch. On the other hand the extensors of the longitudinal arch of the foot are comparatively relatively paralyzed.

The main extensor of the longitudinal arch of the foot is the tendo achillis, next come the extensors of the toes and the tibial ant. muscle.

The main flexors of the arch of the foot or the muscles which increase its height are the flexors of the toes, long and short and the peroneus longus.

The type of paralysis which is most apt to lead to a cavity deformity is therefore the paralysis of the extensor muscles of the peronei of the foot and the combined paralysis of the extensors of the toes. It has been mostly in cases of this type that I have had occasion to try an operative procedure which I wish to describe shortly as follows.

A short incision is made around the heel beginning from the inner tubercle of the calcaneus to the inner side and ending about three quarters of an inch behind the calcaneocuboid joint. The lower surface of the calcaneus is stripped strictly to its inner edge where the short flexors of the toes and the abductors of the first



Figs. A, B, and C. Drawings illustrating the technique.



Fig. 1. Case 1. Infantile paralysis. Residual deformities calcaneonavicular right equinovarus left.

Fig. 2. Case 3. Spastic paralysis congenital. Spastic equinus with considerable cavity right foot.

and fifth toes are inserted together with plantar fascia. Underneath these structures a grooved director is pushed and they are severed or stripped closely to the bone. Thereupon the cavity of the foot at once yields to extension up to the point where the contraction of the accessory

flexor and of the long plantar ligament is responsible for the cavus deformity. In one or two cases I have gone farther and resected these muscles and also incised the long plantar ligament at the calcaneocuboid junction and resected this latter joint but the flap necessary is so long that

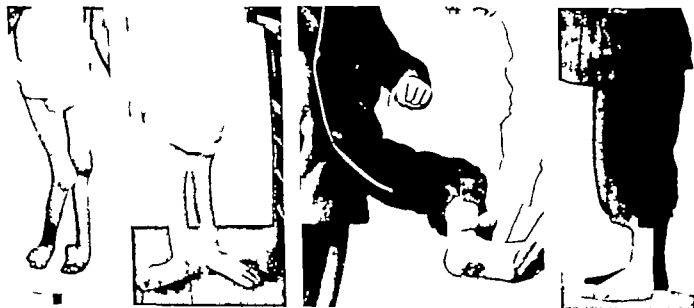


Fig. 4. Case 4. Infantile paralysis with residual deformities of both feet. Left equinovarus with considerable cavity.

Fig. 5. Case 5. Paralytic equinovarus with cavity deformity and contracted structures of the sole and retracted toes a residual deformities of 10 years standing.

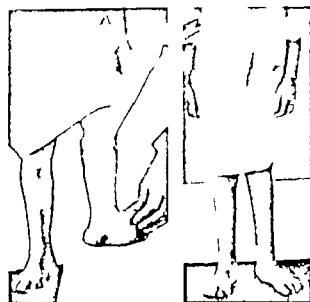


Fig. 5. Case 6. Spontaneous and corrected position of both feet.

its nutrient condition becomes very unsatisfactory and the tendons toughen off. Therefore I have contented myself in most of the cases with the procedure as outlined above and as illustrated in accompanying drawings (Figs. A, B, and C).

C. Ruby A., 6 months old, bilateral congenital clubfoot deformities calcaneo valgus on the right and equinovarus on the left. After operation, as per tibial dissection and medial rotation of the heel, as per

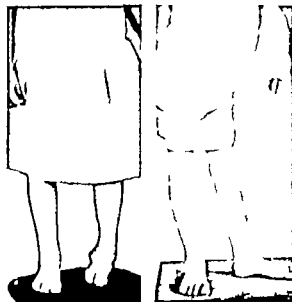


Fig. 6. Case 7. Congenital post-hemiplegic left contractile tenosclerotic equinovarus deformity and contraction of the plantar structures.

formal August 9, 1906. Examination April 4, 1906. The sole of the foot soft and pliable. There is no trace of the former contraction of the plantar structures (Fig. 7).

C. Chester K., age 1 year, bilateral congenital clubfoot deformities, equinovarus on the right, calcaneo valgus on the left. Retraction of the toes, plantar traction, strongly contractile. The foot deformities were corrected by operation, described, July 1, September 9, 1906. Examination after 7 months shows good correction of the deformity, the tendons free, tendons in contraction of plantar structures.

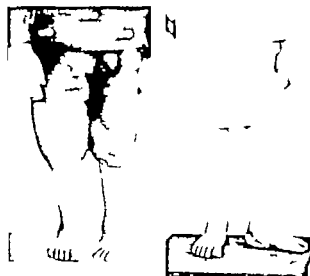


Fig. 7. Case 8. Congenital metatarsus varus with contraction of plantar structures.

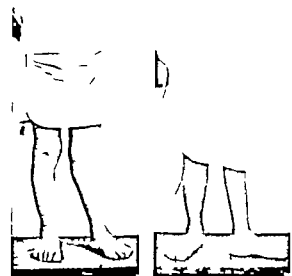


Fig. 8. Case 9. Congenital clubfoot left.

**CASE 3** Harry S. age 6 spastic paralysis congenital deformity of right foot. Spastic equinus with considerable cavity. Operated on September 1915 (Fig 2). Re-examination after 8 months shows no tendency to recurrence of the contraction of the plantar structures (Fig 2).

**CASE 4** Leonard S. age 7 infantile paralysis with residual deformities in both feet. On the left side equinovarus deformity with considerable cavity. The cavity deformity was corrected as described by stripping of the os calcis after the tendo achillis had been lengthened. Re-examination after one year shows that there is no tendency to recurrence and the structures in the sole of the foot are soft (Fig 3).

**CASE 5** Ralph B. age 12 paralytic equinovarus with cavus deformity and contracted structures of the sole and retracted toes as residual deformities of nine years standing. Operation November 30 1911 consisting in plastic lengthening of the tendo achillis and stripping of the os calcis as described. Re-examination 3 months later does not show the slightest tendency of recurrence of the contraction (Fig 4).

**CASE 6** Pearl B. age 8 spastic equinovarus and cavus deformities on both sides congenital. Operation February 15 1916. In addition to the stripping of the os calcis and the resection of the short flexor there was also done a resection of the deeper muscles. The long plantar ligament was incised over the junction between the os calcis and the cuboid and part of this joint was resected. This enabled a good correction of the cavus deformity. The flap which had to be made considerably longer on the outside of foot in order to reach this point did not show sufficient vitality and on one side considerable sloughing occurred over the heel. This interfered greatly with the final result on this side while that of the other side was satisfactory. Ten months later the left foot shows a good and complete correction the right where the sloughing had occurred shows slight tendency to inversion (Fig 5).

**CASE 7** Cecelia H. age congenital spastic hemi-

plegia left. Contracted tendo achillis with equinovarus deformity and contraction of the plantar structures. Tenotomy of tendo achillis and stripping of os calcis April 12 1916. Re-examination 6 months later shows complete relaxation of plantar structures (Fig 6).

**CASE 8** Stanley K. age 5 congenital metatarsus varus with contraction of plantar structures. Stripping of os calcis and redressment May 6 1916. Re-examination 6 months later showed good correction the plantar structures being soft and relaxed (Fig 7).

**CASE 9** George W. age 5 congenital club foot left. Stripping of os calcis August 21 1916. Re-examination 3 months later showed good correction of the cavus deformity. The structures of the os calcis are relaxed (Fig 8).

**CASE 10** Frances A. age 11 infantile paralysis five years standing residual deformity left paralytic equinovarus with contracted plantar structures. Lastly of the tendo achillis and the stripping of os calcis October 3 1916. Complete correction. Too soon for definite report.

All these cases were kept in plaster of Paris casts and in the best possible correction of the cavus deformity for a time of two to six months. No further fixation was employed. I could not detect any tendency of the plantar structures to contract again after the operation and believe that the detached muscles are apt to reattach themselves higher up on the lower surface of the os calcis and therefore do not show any tendency to contraction. For this reason I feel that this operation can be recommended for such deformities because it remedies the trouble at least to the extent to which the contraction of the plantar fascia and the superficial layer of the musculature of the sole are responsible.

## A UNIQUE REPAIR OF AN UNUSUAL JOINT INJURY

By PHILIP W. DAVIS, M.D., PORTLAND, MAINE.

Assistant Surgeon, Maine General Hospital.

CHARLES Q. entered the Maine General Hospital August 19 1915. He was assigned to the service of Dr. William H. Bradford and came under my care as an emergency accident case. Mr. Q. hit at work for the Portland Co. Storage Company caught his sleeve in a circular saw. His left forearm was severely lacerated near the elbow joint. A tourniquet was applied and he was brought to the hospital without delay. Examination under ether showed a rather ragged wound crossing the back of the left forearm just below the joint. Both ulna and radius were found dislocated. The head of the radius was entirely free and fell out on the table while the tourniquet was being removed. There was little hemorrhage and the radial pulse was good at the wrist. Before etherization the extent of the nerve injury could not be ascertained. Mr. Q. was unable to flex or extend his fingers. I hoped this was due to the pressure of the tourniquet.

In this injury all the extensor muscles arising from the external condyle of the humerus and crossing the joint

together with fibers of the anconeus and supinator must have been severed. The orbicular ligament was torn and the joint capsule opened. The posterior interosseous artery was the only vessel of importance cut.

**Treatment.** The wound and adjacent skin were very carefully cleansed. Full strength tincture of iodine was used on the skin the joint cavity and wound were flushed with hot normal salt solution. The button like head of the radius was then tacked onto the radial shaft with a galvanized iron wire nail about one inch and a quarter long a suitable hole first being drilled through the radial head. The natural cup like depression in the cartilage made it unnecessary to countersink the head of the nail. The frag-

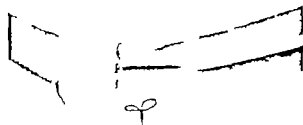


Fig. 1. Incision taken for exposure of the joint.

ends of the ulna were then brought together with silver wire. Several fine catgut sutures were placed to repair the torn capsule of the joint and the severed muscle fibers were united in like manner, particular care being taken to restore the supinator which wraps the upper part of the radius in a sling. The arm was held without drainage except that provided by the wire uniting the ulnar fragment. A plaster dressing was applied from the ends of the fingers to the axilla and a window left through which the wound might be reached if necessary.

On September 3 roentgenogram was taken which showed very fairly the position of the part. On September 10 roentgenograms were again taken one of which is shown in Fig. 2.

Three weeks after the day of operation I removed the wire from the ulna and the plaster splint was dispensed with. At this time useful passive motion was begun. Flexion and extension of the digit and the wrist joint were now normal. There had been no suppuration of the wound and very little swelling of the tissues about the elbow joint at any time. The lower quarter of the wound was so torn and damaged by the original injury that a granulating surface was left which made it necessary to apply

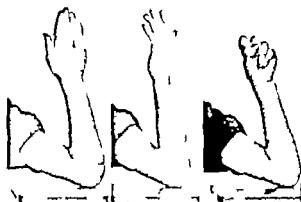


Fig. 2. Photographs showing amount of flexion and extension of the arm 4 months after injury.

dressings, thus prolonging the stay of the patient in the hospital. On October 7 Mr. Q. was discharged. Motion at the elbow joint was about three-fourths normal as regards flexion and extension. I saw him at work 3 weeks later in the cooperative shop. Flexion and extension had improved and he had some pronation and supination. On December 5 I examined Mr. Q. again and found flexion was normal while extension was not quite perfect. Roentgenograms taken at this date showed the condition of the joint with the nail still *in situ*. The photographs in Fig. 3 show the amount of flexion, extension, pronation and supination which had been attained four months after the injury.

## A SIMPLE AND EFFICIENT SUTURE FOR FATTY OR INFECTED ABDOMINAL WALLS

By ARNOLD SCHWYZER M.D. F.A.C.S. St. Paul, MINNESOTA

THE little device does not deserve the dignity of a paper but it has given such satisfactory results that I feel sure some of you will be glad to know of this means of safely closing the abdomen when certain conditions render it difficult. First of all let us assume the case is a badly infected one we often see the peritoneum take care of the infection in the abdominal cavity we only must allow of an exit for collections of larger quantities especially where the peritoneum has been altered to a common abscess wall as in the later stages of a local purulent peritonitis. We have learned through Ochsner that if we allow the intestines to remain quiet a rapid agglutination occurs in the periphery of the local peritoneal infection and through this walling off process the infection becomes localized. The abdominal walls in these cases however, do not dispose of the infection thus easily. While the peritonitic symptoms may promptly subside the wound may look frightful a tendency to sloughing in the fascia fat and skin can be seen and even if the

deep layers hold extensive suppuration in the superficial layers often becomes obnoxious and delays the recovery. The less we suture the less there is tendency to extensive sloughing. Especially the subcutaneous fat and the skin edges underneath tight sutures are prone to undergo sloughing. The interference with circulation by compression of the parts greatly reduces the resistance of these tissues against infection. With a suppuration and retention in these superficial layers the fascia underneath is so much more endangered and where at times it might have resisted a certain degree of infection it may be brought to sloughing by retention of vicious material.

The stitches of our suture emerge far enough from the wound and are so far apart that they do not interfere with the circulation of the skin edges. They are tied over gauze which mitigates the pressure and hinders the sutures from cutting through. Unabsorbable buried suture material cannot be used in infected cases. Catgut is unreliable as to its lasting quality in supporting wounds. Besides that it becomes succulent and offers itself not only as a safe hiding and breeding place for the bacteria but it invites them to follow the stitch channels into the tissues more distant from the cut surface. The ideal suture material would be a strongly and lastingly antiseptic thread. The silver thread comes nearest to it. The silkworm gut is so smooth that it does not give shelter to the bacteria.

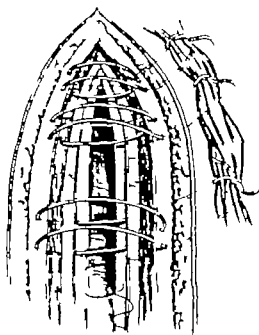


Fig. 1. The two upper threads run with one of their loops through the peritoneum for its approximation. The lower suture shows the course of the thread when the peritoneum is separately closed with catgut.

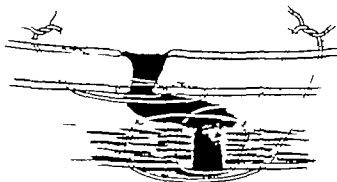


Fig. 2. For the sake of simplicity the threads are sketched as though they were running in one plane. In reality the two loops of the same thread are not in the same plane nor as a rule are the two superimposed threads.



and it is less clumsy than silver wire. These two material thus are best fit for a wound where serious infection obtains. The less catgut used in these cases the better. Mostly one can get along well without any.

If the intestines are ballooned and if the wound has a tendency to gape a reliable suture is necessary to retain the intestines. The suture must guarantee a firm apposition for the muscle and fascia layers but if we apply a simple through and through or a figure of 8 suture we exert a deleterious pressure on the skin and subcutaneous fat if we use sufficient pressure to make it hold with out the addition of catgut. A suture therefore which does not compress these superficial layers and which allows us even to leave them open must have distinct advantage. It can have the subcutaneous fat open and under no pressure at all we also reduce more or less the danger of a severe infection of the fascia and muscle layer. This is an important point. We can even employ a moist antiseptic dressing say with argyrol etc. down to the fascia layer or close to it. Or we can unite the skin with fincat sutures without any tension.

Another distinct advantage which I have appreciated many times is that after the fascia layer has been closed and the suture tied the suture can be inspected and adjustment proved if necessary. Weak spot can be felt and a suture added if needed. And in the end an incision for instance with a depth of three inches and a length of eight inches is safely closed with not more foreign material in the wound than half a dozen silkworm gut sutures each of which forms a double loop. We have named it the lateral double loop stitch. The sketch explains it very readily and you can see that if the sutures emerge not too near the wound the skin edge is somewhat drawn toward the wound. In fact you are able to use this approximating force as much or as

little as you like. Often we have seen the skin edges so well approximated that it needs only a few stitches to keep the skin in correct apposition. Where we want to make use of this approximation of the skin we can alternatingly insert the sutures from both sides. Where we suture the muscle and fascia layer in two layers we insert the deep sutures from one side and the more superficial one from the other. This gives us an overlapping and strengthens the wound (Fig. 2).

In some patients the tissues which have once been seriously infected are very prone to suppuration at a later attempt at closing of an abdominal hernia.

One has to be careful not to handle these tissues more than absolutely necessary. They should be cut not torn. Catgut ought to be avoided if possible and the less suture material there is in the wound the better.

I am often asked if these sutures are easily removed. For the most part they are not unless a little trick is employed that is the sutures are cut one day and the next day they are pulled out. In this way the sutures work themselves loose and come out without trouble if one avoids making an error when putting them in.

I sum up the advantages of our lateral double loop stitch here.

1. It is a tight reliable suture with a removable thread.

2. It approximates the deep layers more firmly than the figure of 8 or the ordinary through and through suture.

3. You can inspect the fascia suture after it is tied.

4. The edges of the skin and fat are left free from pressure.

5. You can drain the whole fat area if desired or leave it open.

6. The suture does not easily cut through. It is therefore especially useful in infected and in fatty abdominal wall.

# EXTERNAL URETHROTOMY, ITS TECHNIQUE

By JOSEPH FRANCIS MCCARTHY M.D. F.A.C.S. NEW YORK

WHENEVER a symposium is presented on the subject of the treatment of urethral stricture the participants therein align themselves on the basis of three or perhaps four decidedly different viewpoints. This attitude would in the writer's opinion seem perfectly admissible were it not for the fact that they contend, and assertively so for their preferential technique to the exclusion of other methods of treatment when is a matter of fact each of the procedures discussed has its particular field of usefulness and the ability of the surgeon is never more manifest than in his selection of the route or mode of attack.

As it is the writer's intention to make the subject of technique the paramount one in this communication the indications will be but briefly considered. It may also be well to note here that unless otherwise stated constructions at or about the bulbo-membranous junction will constitute the type. In fact if one is to judge from textbook and monograph descriptions there exists a real need for a rational technique.

The choice of procedure depends in large measure upon the following: The duration of the lesion, the condition of the urine, the presence or absence of urethrocystitis and its intensity when present, the intelligence of the patient, his resisting capacity, his probable attitude toward regularity of treatments when for example gradual dilatation has been undertaken and in such instances the relative permanency of effect of such instrumentation, the presence of complicating features such as fistulae, recurrent attacks of Cowperitis, the condition of the prostate and whether or not there has been a previous operation.

The above constitute a few of the motivating factors in selecting the method of intervention. Another factor worthy of note is that stricture of long duration has as an aftermath one or more of the following conditions: a trabeculated bladder, residual urine, secondary infiltration or angulation of the vesical sphincter, dilated prostatic ducts frequently filled with pus.

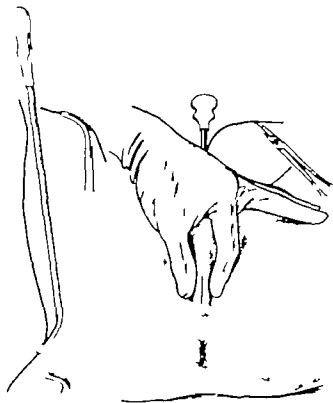
Based upon personal experience in a large number of cases of all varieties of urethral stricture the writer regards the following as justifiable indications for external urethrotomy: urethral stricture of filiform caliber associated with recurrent attacks of Cowperitis, with acute or chronic urinary infiltrations with urethro-

perineal fistulae or with purulent cystitis, multiple stricture of filiform caliber, secondary operations, traumatic stricture of remote origin and such cases of filiform caliber stricture as would seem to require real supplementary drainage.

This operation of external urethrotomy, a description of which follows is one of the most precise and orderly procedures in the entire domain of surgery and in the hands of the writer has been productive of gratifying results. The technique like most good things is the result of the cumulative work of a number of men, among them Arnot, Gouley, Otis and Hayden. The necessary instruments are olive-tipped whale bone filiform, Hayden perineal staff, dissecting and mouse-tooth forceps, Arnot's probe, pointed director, Gouley beaked bistoury, curved blunt bistoury, one long slender gorget, Teale gorget, pair Allis clamps, Otis urethrotome No. 36F, perineal tube with terminal and lateral eye.

## TECHNIQUE

For a day or two before as well as for several days following the operation the patient should



Figs 1 & 2

Fig 4

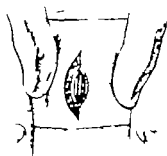


Fig 5



Fig 6a



Fig 6b

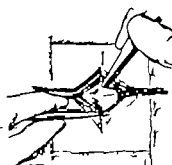


Fig 7

be given large quantities of water urotropin and 50 lum benzoate 10 grains of each three times a day. It is well to pass a filiform when possible before the administration of the anæsthetic inasmuch as the permeability of the urethra to the passage of a filiform at one time is no criterion of its ease of passage at another. This step therefore may obviate unnecessary loss of time during the administration of the anæsthetic. The filiform should be of the whalebone type and bulbous or olive tipped on both ends. A water soluble lubricant is at first employed. One good filiform is better than many. When the operator encounters difficulty in passing the ordinary straight filiform he should then select a new one and bend it into bayonet shape. Following ineffectual attempts the urethra may be distended with a novocain adrenal mixture or with a lrenalin inhalant. When this has become effective the urethra is to be ballooned with warm sterile olive oil. Success attends these steps in the vast majority of cases. In an experience of fifteen years at Bellevue Hospital I have never found it necessary to resort to retrograde dilatation. Occasionally in single structure the urethroscope is of considerable assistance in the passage of a filiform.

#### OPERATION

With the patient in the dorsal lithotomy position the buttocks just at the edge of the table the filiform *in situ* a Hayden perineal staff is

passed over it well down to the point of structure and a small clamp attached to its free end.

Figure 1 shows the perineal staff ordinarily employed. It is faulty because the filiform passes over the groove on the convexity.

Figure 2 is the Hayden staff. Here the filiform passes along the concavity of the instrument leaving the convex groove free.

With this staff shown in Figure 3 the danger of cutting the filiform in making the customary incision is practically nil.

Figure 4 depicts in a general though incomplete manner the next step. The left hand of the operator is in the position shown making tense the bulging perineum and a median incision from three quarters to one and one quarter inches between the bulb above and the anus below is at once carried down to the groove in the staff. The right hand of an assistant who stand on the left side of the table guides this staff under the direction of the operator. Practically the steps in the incision are about as follows. A median incision through the skin and superficial structures then the point of the scalpel is plunged down to the staff followed by a slight upward movement enlarging the incision somewhat. At this stage a pair of straight sharp pointed scissors will better serve the purpose of lengthening the urethral incision.

Figure 5 illustrates this stage of the operation at which point the urethra is seized on either side



Fig 8

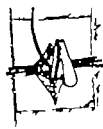


Fig 9a



Fig 9b



Fig 9c

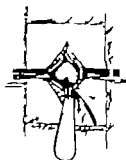


Fig 10

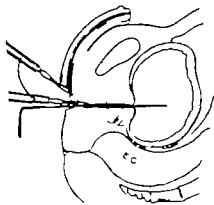


Fig 11

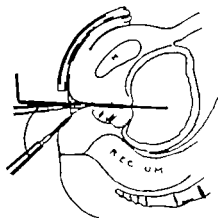


Fig 12

of the incision with Allis clamps and the staff partly withdrawn until the filiform is seen. This step is seen in Figures 6 a and b but it should be noted here that the drawing is deliberately exaggerated for purpose of demonstration. As a matter of fact the staff is withdrawn sufficiently to grasp the exposed filiform with a pair of smooth forceps and fixed, at which time the staff may be withdrawn without fear of pulling on the vesical end. This is well drawn in Figure 7. Here the lower or left hand fixes the vesical end with smooth forceps while the right hand with mouse tooth forceps delivers the penile end downward and outward through the incision as observed in Figure 8 and the assistant withdraws the Hayden staff. An Arnot probe pointed director is next passed along the filiform the direction is at first downward and forward, later upward until it reaches the bladder.

Figures 9 a b and c illustrate perhaps the most difficult step in the operation. This step requires considerable judgment as to direction. The tendency of the average operator who is seated facing the operative field, is to pass the director

on a line parallel with the patient's body whereas his efforts should be directed at an angle of 45 or more degrees. Occasionally the constricted urethra hugs the filiform so tightly that it may be difficult or even impossible at first to pass the probed director. In such event the constriction is incised in the median line until the filiform is fairly free in the canal. On a few occasions the writer has employed a director provided with an eye so that it might be threaded over the retained filiform. This was discarded after a number of filiforms had been broken off in the bladder.

Finally in essaying the passage of the director it is essential to remain constantly in the median line. Figure 10 illustrates the termination of this step. The filiform is now withdrawn the director remaining. With the groove facing upward a Gouley probe pointed bistoury is passed along it until slightly beyond the stricture which is severed on withdrawal of the knife by cutting the stricture on the superior aspect in a semi-circular direction—upward and outward (Figure 11). The director is now rotated so that the groove faces the rectum whereupon the

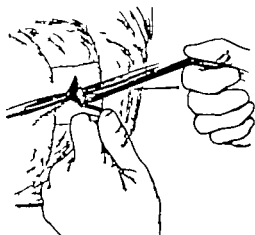


Fig 13

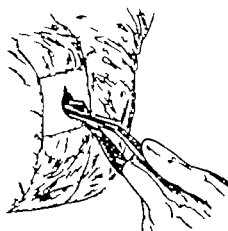


Fig 14

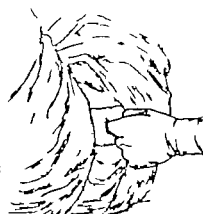


Fig 15



Fig. 24 and 25. Case 1. Upper eyelid gunshot defect. (Unshot) outline of cheek and chin.

Fig. 26 and 27. Case 2. Injury to lower half of left ear and part of cheek.

Fig. 28 and 29. Case 3. Correction of scar following trepanning and skin graft after injury to lower lip.

has become the standard method and that it is not fallen back as often the case requires. However, high results are recognized from afar. Anvessel II trait on I C also this condition badly treated. (Fig. 24)

CASE 3. Infant, an I Royal Reserve, II patrol N. 8. A nose had penetrating lower lip under a gunshot wound in the parathyroid and soft part scar. The latter entirely surrounded the nose. Was removed by an and repaired by a nasal seam. (Figs. 28 and 29)

CASE 4. Soldier D. R. Reserve, II patrol N. 7 in Vienna suffered critical point of the upper lip from

gunshot wound in cheek after the repair healed leaving no trace of the injury. (Fig. 30 and 31)  
CASE 5. Same as Infantryman I S Royal Reserve II patrol N. in Brunswick had an upper eyelid gunshot defect which was improved by excision of broken parts and making smaller eyelid (Fig. 32)

#### B. SIMPLE LINE. 1. AFTER SCAR TO SKIN EXTENT

CASE 6. Infantryman Z. Royal Reserve II patrol N. Brunswick. Gunshot wound of cheek and nose resulted in scars which were both cut out (Fig. 33 and 34)



Figs 32 and 33. Case 14. Shot through cheek and adjoining nostril. Fig. 33 shows the final result.

Figs 34 to 41. Cases 15 and 16. Correction of deep broad cheek scar (Figs. 34 and 35) and deep fixed temple scar (Figs. 36 to 41).

1) Because the cheek wound was too nearly round it was lengthened by excision of normal cheek skin. A large piece of adjacent subcutaneous tissue was removed to imitate there the condition of the original wound the scars of which had been excised. The entire wound was then closed with equal tension (Figs. 24 and 25). In this case I had to be careful on account of the Stensen's duct and facial nerve. The scar on the nose was repaired by a small pedicle flap (Figs. 24 and 27).

CASE 12. Infantryman S. V. of the same hospital (Figs. 26 and 27) had the outer half of his right ear and a part of the cheek shot away. The cheek defect was closed by homologous skin after the excision of healthy skin as in case above which then gave good conditions for repair.

CASE 13. Similar procedure was followed in the case of infantryman I. P. (the same hospital) to correct a scar fixed on the skull after trepanning. A soft part scar fixed on the lower jaw from another shot was also improved. On the forehead the closing of the bone defect was made with a pedicled bone flap (Figs. 8 to 13).

#### 2. 4. COMPLICATED LINEAL SCAR WITH UNDERLAY FROM DIRECT NEIGHBORHOOD

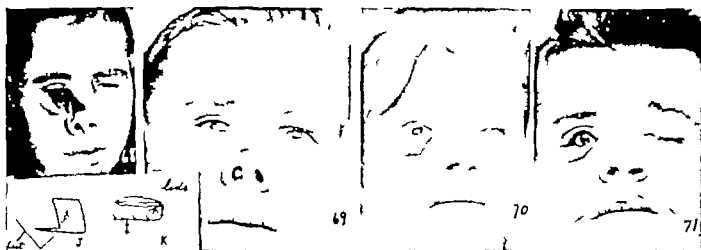
CASE 14. Infantryman J. P. Vereins Reserve Hospital 0 in Bruenn was shot through the cheek and adjoining nostril (Figs. 32 and 33). I prepared the plastic for this by



Figs. 42 to 45. Cases 1 and 8. Correction of deep fixed scars on cheek.



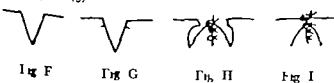
(See legend p. 4.)



(Figs 46 to 67 see p. 744)  
 Figs 46 and 47 Gunshot wound of jaw Skin scar corrected  
 Figs 48 to 51 Different stages in the correction of nose deformity  
 Figs 52 to 56 Correction of fixed scar at corner of mouth  
 Fig 57 to 60 Mutilating face injury  
 Figs 61 and 62 Case 23 Upper cheek wound

Figs 63 to 67 Cases 4 and 2 Corrected with underlay of free transplants of fat  
 Figs 68 and 69 Case 20 Lower eyelid and nose defect  
 Figs 70 and 71 Case 21 Eyelid mutilation Fig 71 shows the condition before an attempt to smooth the flap scar  
 Figs 72 to 74 Case 8 Upper lip defect Result seen in Fig. 74

cutting laterally on both sides into the deep tissue and then by sewing the mobilized subcutaneous tissue together to raise up to a good level the skin suture line which then followed (see Figs F to I). Figure 33 shows the final result.  
 Cases 15 and 16 I did a similar operation on Infantryman N (in the same hospital) for a deep broad cheek scar and on Infantryman V in Royal Reserve Hospital No. 8 in Vienna for a deep fixed temple scar which followed the panning (Figs 34 to 4).  
 Cases 17 and 18 Infantrymen S and K, Veterans Reserve Hospital No. 1 in Brunn Both had deep fixed scars on the cheek which were removed in similar way (Figs 42 to 45).



Case 19 Infantryman I Reserve Hospital No. 17 in Vienna following a gunshot wound of the jaw had a defect in which the skin scar was corrected (Figs 46 and 47).  
 Cases 20, 21 and 22 are three patients who were operated upon by very distinguished surgeons. Their wounds healed perfectly from a surgical point of view, but the patients were not socially presentable so that I received them for corrections.  
 Sergeant V in peace time had an infection of paraffin in his sunken nose bridge. In the winter of 1915 on the Carpathian front the skin covering the paraffin froze and necrosed. The defect was closed at that time with a pedicle flap from the forehead. The flap however was so prominent that the patient had a wax shell made to cover the nose. The correction which I made was merely to cut out the scar on one side and to diminish the soft tissue on the side of the flap by placing it partly under the opposing skin edge before suturing. After the operation I repeated this operation on the opposite side (Figs 48 to 51).







Figs 80 to 82. Case 31. Gunshot injury of jaw.  
Fig. 83 and 84. Case 84. Gunshot injury of jaw.

Figs 85 to 87. Case 33. Mutilating injury of chin.  
Fig. 88 to 91. Loss of entire nose except bony skeleton.

to his right eye and received a lower eyelid and nose defect. I will show here only the lower eyelid treatment. The right side of the wound which contained the greater part of the lid was mobilized to form the new lid (see Figs. J and K). The new small eyelid was stretched by gradual increasing the size of the artificial eye.

CASE 29. Infantryman M. Royal Reserve Hospital No. 8 in Vienna (Figs. 75 and 76) had a similar eyelid mutilation and an artificial eye could not be introduced. He came to me after having been unsuccessfully operated upon. The new plastic was made in a manner similar to that in the preceding case. Figure 77 shows the condition before an attempt to smooth the flap scar. The patient has closed his healthy eye.

3 b. DISPLACEMENT OF ONE WOUND FLAP AFTER MOBILIZING IT BY SIMPLE CUT WITH NARROW PEDICLE.

In the case of Infantryman S. (Figs. 78 to 81) in above hospital a small hairy pedicle flap (pedicle at top) was placed after scar excision in the under lateral part of the

left lip defect which was raised. This was taken with pedicle at angle of mouth. Secondary defect was sewn together. Later a pedicle flap from the middle of the under lip was placed in the upper lip (Figure 82) shows result.

CASE 30. The patient Infantryman J. Royal Reserve Hospital No. 8 in Vienna (Figs. 79 and 80) had lost the under part of left upper lip and in addition he had deep scars upward and laterally in the cheek. After excision of all scars a large pedicled flap of the orbicularis oris with mucous membrane from the underlip was used. The functional as well as the aesthetic result was very satisfactory.

CASE 31. Infantryman S. same hospital (Figs. 81 and 82) had lost the upper half of the ear and half of the lobe. After spreading out all the skin of the remaining auricle on its anterior surface the back wound was covered with a pedicle flap from the neck. The ear looked almost normal afterward. The secondary defect was sutured. For the upper auricle defect the entire hairless skin behind the ear

used the pedicle from the top. The flap doubled over. The secondary defect was closed with a free transplant from the arm using the Krause method. After union occurred, the flap of cartilage was taken from the nose, too large for use in ear and used to model the nose. When the child left the patient as she, the Society of Surgeons Vienna.

### 3. C. BEAM WITH DISPLACEMENT OF ONE WOUND FLAP AFTER MOBILIZING IT BY SIMPLE CUT WITH AN ISLAND FLAP

In many cases I used skin flaps which had no skin pedicle for covering defects especially near the angle of the mouth. These flaps had a subcutaneous pedicle including the external maxillary artery. The flaps have many particular advantages respecting the nourishment, beauty and practicability. The patients of this kind are to be separately described.

### 4. BEAM AFTER MOBILIZATION TO BOTH FLAPS

The frequent appearance in war of total or partial lower lip defects with or without jaw injuries gave me a great number of similar cases of which I shall mention only a few examples. In all these cases I was able to make the repair with tissue from the neighborhood often by mobilizing the flaps by large curved cuts. The scars were always entirely removed. The tension was divided over the largest possible surface which often included large areas on the neck. The formation of a new mouth was always a difficult task because of the necessity of getting well formed and movable lips. The new orbicularis oris was always first constructed even though the mouth became very small. The mouth was then enlarged later by stretching apparatus or operation. Unequal upper and underlips were often equalized by the methods of Lexer or Latschender from the middle or from the side.

Case 3. A Russian soldier of 30 years of age, wounded in the head by a bullet from a machine gun, was brought to the Hospital of the Austrian Army in Vienna. He had a severe injury to the face and head. The bullet had entered the mouth and had passed through the upper lip and the lower lip, and had exited from the back of the head. The patient was brought to the Hospital of the Austrian Army in Vienna. He had a severe injury to the face and head. The bullet had entered the mouth and had passed through the upper lip and the lower lip, and had exited from the back of the head. The patient was brought to the Hospital of the Austrian Army in Vienna.

The whole skin of the chin and the remains of the lips were mobilized by curved cuts. All were then sutured (Figs. 1 and 2). Similar to Morgan's method I drew an ordinary curved incision into the jaw after having previously bored through the outer table. This was for the purpose of holding the skin up over the chin. However, my nasal was driven much deeper and it directed downward.

Case 3. A Russian soldier of 30 years of age, wounded in the head by a bullet from a machine gun, was brought to the Hospital of the Austrian Army in Vienna. He had a severe injury to the face and head. The bullet had entered the mouth and had passed through the upper lip and the lower lip, and had exited from the back of the head. The patient was brought to the Hospital of the Austrian Army in Vienna.

Case 33. Infantryman P. V. (Figs. 85 to 87). I had the honor as guest of operating on him in the clinic of von Hochberg. The lower lip as formed by mobilizing the right and left sides of the defect together with the left end of the upper lip (See Figs. N and O). It should be mentioned that a large pedicle flap from the scarred skin of the chin was used as a substitute for mucous membrane because the lack on account of its ugly scars could not be avoided. But in the mouth cavity long curved incision was made in the right form as deep as possible and ending suddenly the vertical one inch cut to mobilize the right flap. The healing of all the flaps was complete except for a fistula which formed at the tip of the former left cheek scars which had been removed. The fistula soon disappeared spontaneously. I order to avoid complications the denture on all but not went on to some corrections which followed.

Case 34. Infantryman J. T. (Figs. 88 to 91). He had a severe injury to the face and head. The bullet had entered the mouth and had passed through the upper lip and the lower lip, and had exited from the back of the head. The patient was brought to the Hospital of the Austrian Army in Vienna. He had a severe injury to the face and head. The bullet had entered the mouth and had passed through the upper lip and the lower lip, and had exited from the back of the head. The patient was brought to the Hospital of the Austrian Army in Vienna.

The nose skin was then supported with a wire pads until the new bone skeleton took up the function. The nostril were formed from pedicle flaps of the nasal labial fold. The upper lip has still been enlarged from the lower lip by Lexer's method. The modification on the new skin setum of the nose. It benefited from the skin over the chin. The almost invisible closing of the secondary defect. Figure 91 shows the patient's skin protruberance resembling a horn on the chin. This is a defect he suffered by the Lexer operation. He had a severe injury to the face and head. The bullet had entered the mouth and had passed through the upper lip and the lower lip, and had exited from the back of the head. The patient was brought to the Hospital of the Austrian Army in Vienna.

## FREE MUSCLE-TENDON-BONE TRANSPLANTATION FOR OLD FRACTURE OF THE PATELLA

By WALTER M. BRICKNER, M.D., F.A.C.S., NEW YORK  
Associate Surgeon Mt. Sin. Hospital

**A**S a farmer of 57 in good health was referred to me on July 15, 1916, by Dr. Herman Schwartz with a transverse fracture of the right patella which he had sustained more than a year before and for which he had had no treatment whatever.

The quadriceps was very much atrophied and contracted and the patellar fragments of equal size were widely separated. I thought however that under narcosis and with the assistance of liberating incisions in the muscles I would be able to secure approximation.

At operation (July 17, Park Hospital, ether) I found that traction on the exposed upper fragment of the patella brought it down but very little indeed. Vertical incisions were then made through the muscles on each side of the rectus femoris, in the lines *AB* and *CD* (Fig. 1). But even when these had been gradually extended the full length of the quadriceps bursa and a little beyond, the upper fragment could be moved down but little more than before; the separation was still about an inch.

A transverse incision (*EF*) was made partly across and through the thickness of the restraining rectus femoris tendon. Traction then made the bone approximation a little closer but still very insufficient.

At this stage there seemed nothing to do but to complete the transverse incision *EF* by extending it on each side to meet *B* and *D*. This incision cut the mass *ABDC* from all attachments and

indeed I lifted the upper half of the patella and the attached tendon-muscle mass away from the patient's body!

The freed upper half of patella was then laid in contact with the lower half after freshening the edge of each and the fragments were united with two kangaroo tendon sutures passed through drill holes. The periosteum and the torn joint capsule were stitched with chromicized catgut and the transplanted muscle-tendon mass was sutured in its new bed with kangaroo tendon and chromicized catgut as illustrated in Figure 2. The skin wound (Fig. 3) was closed without drainage and a plaster of Paris cast was applied in full extension. Lane technique was employed throughout the operation.

The postoperative course was afebrile and on the twelfth day the skin wound was found healed *per primam*. On August 5 the patient was discharged from the hospital the leg still in extension in the split plaster cast.

Six weeks after operation the patella was solidly healed. Although the transplanted tendon-muscle mass had shrunk somewhat in bulk, it had not undergone absorption and no separation was palpable in the lines of muscle suture. The quadriceps was however more atrophied than before operation and it showed at no place my response *hacer to galvanic or faradic stimulation*. In spite of the bony union, therefore, the chance of a functional cure appeared to be very small indeed. At that time there was also noted a decided drop foot which had probably developed from nerve pressure by the cast.

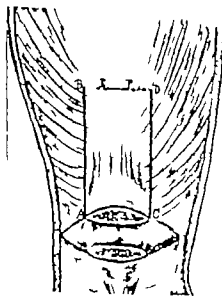


Fig. 1

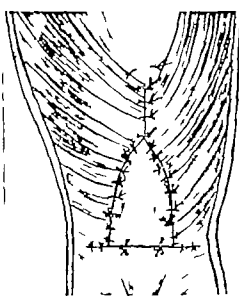


Fig. 2

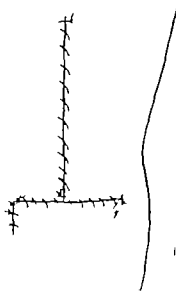


Fig. 3

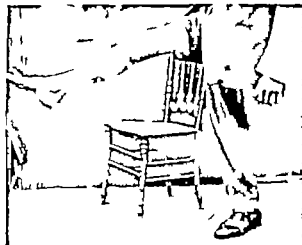


Fig. 4



Fig. 5

This patient, the first of an ungrouped  
competent man, Mr. Karl Stener, had  
an indication of a normal an-  
imal treatment, massage, passive  
flexion, and then a bit of flexion of the knee  
on the floor and the trochanteric angle  
of the leg and demonstrated normal power to  
the leg. The patient was able to  
plantar flex the knee about 4 degrees and  
the foot and the patient walked about  
100 feet.

On October 1, 1941, the patient was brought  
to the New York Academy of Medicine  
by his wife, as a fair bulk and strong

responded normally to electrical stimulation he was able to  
flex the leg fully and hold it in extension  
and did not rise normally from a crouching position  
(Fig. 5) and the knee was normal.

At the time, (February 4, 1942) the drop foot was  
entirely recovered, the man flexed his knee fully, extended  
easily, walked up and down stairs normally, he had fairly  
bulky quadriceps of very good size and old patella of  
normal contour, and he goes about his affairs without effort  
or fatigue.

This report is made not to describe a method  
of choice but to record the excellent result of a  
free muscle-tendon bone transplantation in an  
unpromising case.

## VERTEBRAL FRACTURE WITH LUXATION, TRANSPLANTATION OF BONE

BY HERBERT P. COLI, M.D., I.A.C.S., MOBILE, ALABAMA

THE transplantation of bone for the treatment of spinal tuberculosis is a generally accepted surgical procedure. The transplantation of bony material for spinal fracture, however, is sufficiently unique I believe to warrant a report of the cases.

The unusual features of a recent case of spinal fracture and dislocation required such departure from the usual methods of transplantation that they prompt me to present a report.

Among the essential principles of the transplantation procedure as outlined by Dr. Albee is the approximation of medullary bone to medullary bone wherever possible. In this particular case the vertebral dislocation caused such a distortion of the line of the spinous processes that a transplant could not readily be fixed to the spinous processes by turning down all of the split halves on the same side accordingly the halves

were turned down to the left in the upper portion of the spine and to the right in the lower portion. The tibial transplant was then inserted with its periosteal surface against the medullary surfaces of the fixed halves of the spinous processes above and with the medullary portion of the transplant against the medullary portion of the fixed halves of the spinous processes below. It will be noted in this way that whereas the upper portion of the transplant did not follow the rules of medullary to medullary throughout the insert of the transplant in this manner did prevent lateral motion of the spine and secured much better primary fixation than by the method of turning the halves down all on the same side. The final results amply justified our methods. I append the case report and the self explanatory sketches.

J. R. A. Albany, C. (transferred by Dr. I. K. Arms) aged white male age 4. Past history unimportant in

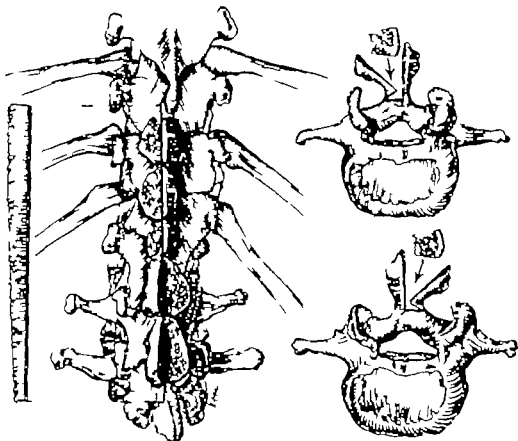


Fig. 1. The lateral deviation of the lower vertebrae prevents an accurate approximation of the transplant by the usual method of turning down the split spinous processes all on the same side. Small sketches represent the manner in which the surfaces of the transplant are presented against the fixed portions of the processes above and below. Note that such fixation of the transplant prevents lateral motion

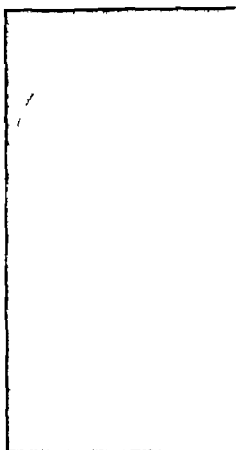


Fig. Radiogram discloses transplant position after operation.

relates to present illness. On March 6, 1904, the patient fell from freight car, striking on his back. About six

months later, kyphosis was noted about the middle portion of the spine. The progressively resultant pain required plaster cast about December, 1900. Since December, 1900, at the present time, the patient has had severe pain in the left leg, and left portion of the back. At the present time, the patient is unable to walk erect and has to walk with support on the left hand on the thigh. Upon this, the patient complains of severe lancinating pains in the left of the dorsal vertebrae and extruding pains in both lumbar regions upon sneezing or coughing. *Calculation.* A definite kyphosis at the level of the tenth dorsal vertebra. All motion painful, especially in the late flexion and extension. Normal motor disturbances. Clinical diagnosis, degenerative. Radiogram showed dislocation and fracture of the tenth dorsal vertebra with partial dislocation of the lower fragment to the left.

*Operation.* A segment of tibia about six inches in length, patterned to fit the kyphosis, was cut from the right internal surface of the tibia. The spinous processes of the tenth, eleventh, and twelfth dorsal vertebrae were split and the left halves turned downward. The spinous processes of the two upper lumbar vertebrae were split and the right side turned downward. The tibial transplant was then inserted after checking all hemorrhage. The periosteal surface of the transplant was placed against the fixed portions of the spinous processes in the upper portion of the kyphosis and the medullary surface of the transplant lay against the medullary surface of the fixed portions of the processes below. This method prevented lateral motion of the spine.

The wound healed without complications and the bony union has evidently been all that could have been hoped for. Pain has been entirely relieved and the latitude of spinal motion is quite remarkable.

# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN GYNICOLOGY AND OBSTETRICS

By GEORGE GELI HORN M.D. St. Louis

SOME months ago we took pleasure in calling attention in these pages to two excellent books by English authors: *The Sex Complex* by W. Blair Bell and *Operative Midwifery* by J. Munro Kerr. A worthy companion to these works has just made its appearance in the *Gynecology* by I. Den and Lockyer.<sup>1</sup> It may not be amiss first to say a word about the authors. Both are familiar and respected figures in the gynecologic world and by numerous original contributions have amply demonstrated their entire fitness for writing a book on gynecology. Both are obstetricians as well as gynecologists — a combination none too common in England yet one which to a certain extent guarantees a proper valuation of our special problems. Indeed I. Den is the author of a popular *Manual of Midwifery*. The intimate correlation of the indivisible sister sciences of gynecology and obstetrics, the numerous points at which they overlap can perhaps best be exemplified by referring to obstetric infection and its remote results and it is this field that is more fully dealt with by the authors than is usual in gynecologic textbooks.

The subject matter is arranged along approved lines. The book is divided into three parts. Of these the first under the heading of General Gynecology comprises anatomy and physiology, methods of examination, prominent symptoms, disorders of development and function, and pelvic infections. Regional Gynecology forms the second part and deals with the affections of the several generative organs while the third part contains the technique and after treatment of gynecological operations.

The authors have succeeded in keeping the instruction abreast of the most modern advances in our knowledge and in maintaining an even balance between the pathological and clinical aspects of the work. The subject of chronic endometritis is firmly based upon the fundamental researches of Hirschmann and Adler. In accordance with these authors only the *interstitial* variety of chronic endometritis is recognized. Such an inflammatory state of the stroma may inhibit the involution which normally occurs in the uterine glands after menstruation thus rendering a physiological and transitory hyperplasia of glands pathological and permanent.

See Gynec. & Obst. 917, 920, 921 and 922.  
Gynecology. For students and practitioners. By Thomas W. Allen M.D., F.R.C.S., F.R.C.P., and Cuthbert Lockyer M.D., B.S., F.R.C.S., F.R.C.P. New York: The Macmillan Company, 916

In the removal of a malignant growth from the vulva it is essential to extirpate the inguinal glands on both sides at the same time whether they are palpable or not. In dealing with hematosalpinx and hamatometria a conservative radicalism is suggested. The chapter on the nature of menstruation and the rôle of the endocrine glands is written under the influence of Blair Bell. An interesting work has been alluded to in the opening sentence of this review.

As to the problems of sterility a little more detail would seem desirable. Important contributions by American authors have not been taken into consideration for instance the studies by Reynolds on the chemical reaction of secretions or the sterility test by Huehner. In anterior colporrhaphy dissection with scissors which we owe to Watkins of Chicago is recommended. From this advanced technique there is a lapse into antiquated and to our feeling faulty technique in the operation for complete tear where the authors tie their sutures in the lumen of the rectum.

But enough of details. The shortcomings are few very few. The attractions and distinct advantages of this book are so numerous that it will easily obtain citizenship on this side of the ocean.

THE case is not quite so plain with another immigrant that seeks admission to our libraries. Jellet's book<sup>2</sup> has undoubtedly a good many attractive features. The theory of gynecology is well worth reading and there are a number of discourses for instance on the mechanism of downward displacement of the uterus or the principles of pessary therapy which testify to the qualifications of the author as a teacher. On the other hand the general disposition of the book is one of unrest. For example you may have become interested in the author's presentation of the subject of uterine cancer and would like to know his position as to therapy. You must however curb your impatience for under the heading of treatment you are referred to another later page. You eagerly find the designated place only to be told that the real treatment will be dealt with later in a separate chapter. Such interruptions disturb one's concentration and continuity of thought. This tearing apart of the discussions of the various topics occurs

A PRACTICE OF GYNCOLOGY. By Henry Jellet M.D., F.R.C.P. Philadelphia: Lea & Febiger, 916.



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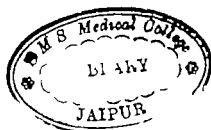
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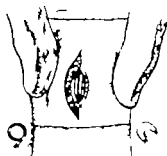


Fig 5

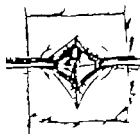


Fig 6a



Fig 6b

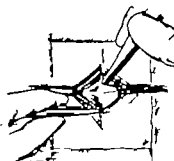


Fig 7

be given large quantities of water, urotropin and sodium benzoate 10 grains of each three times a day. It is well to pass a filiform when possible before the administration of the anæsthetic inasmuch as the permeability of the urethra to the passage of a filiform at one time is no criterion of its ease of passage at another. This step therefore may obviate unnecessary loss of time during the administration of the anæsthetic. The filiform should be of the whalebone type and bulbous or olive tipped on both ends. A water soluble lubricant is at first employed. One good filiform is better than many. When the operator encounters difficulty in passing the ordinary straight filiform he should then select a new one and bend it into bayonet shape. Following ineffectual attempts the urethra may be distended with a novocain-adrenalin mixture or with adrenalin inhalant. When this has become effective the urethra is to be ballooned with warm sterile olive oil. Success attends these steps in the vast majority of cases. In an experience of fifteen years at Bellevue Hospital I have never found it necessary to resort to retrograde dilatation. Occasionally in single stricture the urethroscope is of considerable assistance in the passage of a filiform.

#### OPERATION

With the patient in the dorsal lithotomy position the buttocks just at the edge of the table the filiform *in situ* a Hayden perineal staff is

passed over it well down to the point of stricture and a small clamp attached to its free end.

Figure 1 shows the perineal staff ordinarily employed. It is faulty because the filiform passes over the groove on the convexity.

Figure 2 is the Hayden staff. Here the filiform passes along the concavity of the instrument leaving the convex groove free.

With this staff shown in Figure 3 the danger of cutting the filiform in making the customary incision is practically nil.

Figure 4 depicts in a general though incomplete manner the next step. The left hand of the operator is in the position shown making tense the bulging perineum and a median incision from three quarters to one and one quarter inches between the bulb above and the anus below is at once carried down to the groove in the staff. The right hand of an assistant who stands on the left side of the table guides this staff under the direction of the operator. Practically the steps in the incision are about as follows. A median incision through the skin and superficial structures (then the point of the scalpel is plunged down to the staff followed by a slight upward movement enlarging the incision somewhat. At this stage a pair of straight sharp pointed scissors will better serve the purpose of lengthening the urethral incision.

Figure 5 illustrates this stage of the operation at which point the urethra is seized on either side



Fig 8



Fig 9a



Fig 9b



Fig 9c

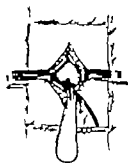


Fig 10

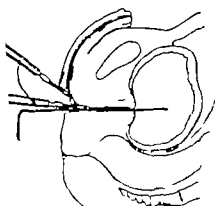


Fig 11

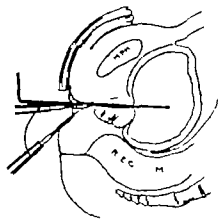


Fig 12

of the incision with Allis clamps and the staff partly withdrawn until the filiform is seen. This step is seen in Figures 6 a and b but it should be noted here that the drawing is deliberately exaggerated for purpose of demonstration. As a matter of fact the staff is withdrawn sufficiently to grasp the exposed filiform with a pair of smooth forceps and fixed at which time the staff may be withdrawn without fear of pulling on the vesical end. This is well drawn in Figure 7. Here the lower or left hand fixes the vesical end with smooth forceps while the right hand with mouse tooth forceps delivers the penile end downward and outward through the incision as observed in Figure 8 and the assistant withdraws the Hayden staff. An Arnot probe pointed director is next passed along the filiform the direction is at first downward and forward later upward until it reaches the bladder.

Figures 9 a, b, and c illustrate perhaps the most difficult step in the operation. This step requires considerable judgment as to direction. The tendency of the average operator who is settled facing the operative field is to pass the director

on a line parallel with the patient's body whereas his efforts should be directed at an angle of 45 or more degrees. Occasionally the constricted urethra hugs the filiform so tightly that it may be difficult or even impossible at first to pass the probed director. In such event the constriction is incised in the median line until the filiform is fairly free in the canal. On a few occasions the writer has employed a director provided with an eye so that it might be threaded over the retained filiform. This was discarded after a number of filiforms had been broken off in the bladder.

Finally in essaying the passage of the director it is essential to remain constantly in the median line. Figure 10 illustrates the termination of this step. The filiform is now withdrawn, the director remaining. With the groove facing upward a Gouley probe pointed bistoury is passed along it until slightly beyond the stricture which is severed on withdrawal of the knife by cutting the stricture on the superior aspect in a semi-circular direction—upward and outward (Figure 11). The director is now rotated so that the groove faces the rectum whereupon the

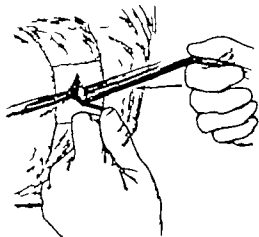


Fig 13



Fig 14

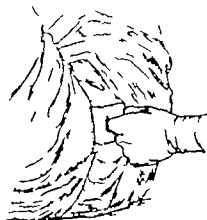


Fig 15



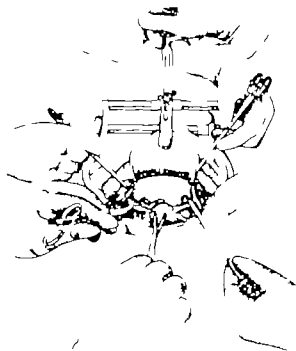


Fig. 3

(sacral sheath. The fund of the uterus is adjusted so that the lower angle of the peritoneal incision is well above it.

The right round ligament is sutured in the same manner to the anterior parietal peritoneum.

The left round ligament is sutured in the same manner.

The line of attachment to the anterior parietal peritoneum is continued from one round ligament to the other across the uterine fundus, bringing the peritoneum all up over the fundus between the tubal insertions so that the linen sutures are all excluded from the abdomen.

The hole in each broad ligament through which the tube passes is now stitched shut on either side by angle over and over light catgut suture.

The advantages of this procedure may be summed up as follows:

1. It is conservative, not requiring the extirpation of any structure.

2. It is well adapted to retrodisplacement of the uterus as it gives an excellent fixation especially if accompanied by shortening of the uterosacral ligaments.

3. It avoids anterior abdominal pillar formation such as have been found objectionable in the Kelly suspension or the Gilham round ligament shortening.

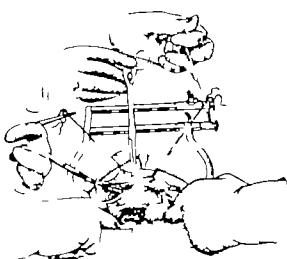


Fig. 4

4. It suspends the ovary excellently.  
5. It maintains the patency and therefore the drainage of the tubes.

6. The anterior pelvic sac is left large enough to accommodate the bladder so that there are no postoperative vesical disturbances.

7. It is a simple, superficial and therefore a speedy operation.

8. It may be combined with therapeutic abortion by the abdominal route up to the sixteenth week of pregnancy as has been proposed by Hoffmann and Sellheim 1913 by Anderes and Kunreuther 1914 and by Findley 1915.

9. It is readily the best procedure for the subsequent restoration of fertility. This would be accomplished by separating the adhesions along the line of ventrosuspension. The tubes could then be freed from the broad ligaments or they could be cut off close to the broad ligaments and treated as suggested by Martin in 1885.

This operation has been performed 31 times, for tuberculosis, nephritis, valvular heart lesion, contracted pelvis in association with repair of complete perineal laceration and high amputation of the cervix as a part of a conservative procedure for the cure of procidentia uteri and with abdominal therapeutic abortion. All patients have had from two to nine pregnancies. All have had living children. They have varied in age from 21 to 42 years. Up to the present time there has been no occasion to attempt restoration of fertility.

SOME OBSERVATIONS ON THE CONDUCT OF THE THIRD STAGE OF LABOR<sup>1</sup>

By H. K. GIBSON, M.D., CHICAGO  
Attending Obstetrician St. Luke's Hospital

IN presenting the following for your consideration I wish to disclaim any suggestion of a special proprietorship or originality for the ideas herein advanced. At various periods during the past years I have found myself groping as it were concerning the proper conduct of the third stage of labor and apparently encountering more difficulties by reason of a deviation from the normal mechanism than any one of my acquaintances.

In my earliest years I religiously held and massaged the fundus to see that it remained in a state of tonic which it occasionally did for an indefinite period and even today I find that nurses and internes almost without exception are obsessed with the idea that watching the uterus implies uninterrupted manual attention, which they are never loath to render in varying degrees from light but continuous pressure and massage on the fundus, to pressure sufficiently marked to cause the cervix to present at the vulva, in attempting a Crede.

The separation of the normally situated placenta is or should be just as distinct a physiological entity as the birth of the child. Of course it is no more possible to govern the conduct of the third stage by a fixed dogma than it is the second. Yet, I am more and more impressed with the fact that even those basic precepts dwelt upon as far back as Baudelocque (1) in his time and strangely enough absolutely ignored by such a master as Crede are often lost sight of.

I refer to the distinction between separation and expulsion of the placenta. Crede (2) in defending his procedure as he was speedily called upon to do referring to his first two thousand cases at Leipzig remarks that the average time of expulsion in this series of cases was four and one half minutes. He tells us further that he expressed the placenta usually with the second or third contraction. Furthermore that in eighteen cases the entire chorion and in seventy eight parts of it were retained. That forty two of these cases developed light temperature not over 39 C. and repeated chills however that eighty one of the ninety one women left the hospital on the twelfth day and ten left later. Strangely enough, it would seem that one has approached the simplest and most natural method

of conducting the third stage only by a long and devious route.

Contemporary textbooks particularly in English with one or two exceptions devote neither the space nor the stress to the subject of separation of the placenta as distinguished from expulsion that this all important chapter in obstetrics so fruitful of morbidity demands. It has seemed to me moreover that the phraseology employed is often misleading and more often misinterpreted. In the absence of hemorrhage which, if it cannot be determined visually and by the patient's pulse may be suspected by a momentary outlying with the fingers of the height and consistency of the fundus. I repeat, that in the absence of any sign or indication of hemorrhage the phrases kneading the uterus, gentle massage of the uterus, steady ing the fundus, holding the fundus lightly but continuously are not only misleading and misinterpreted, but are in an overwhelming percentage of normal cases entirely uncalled for and not justified by the facts. French writers notably Pinard and Barr (3) have insisted upon the existence of a so called state of physiological inertia following immediately upon delivery. Barr estimates its duration as between five and fifteen minutes and I believe that most of us have observed this period of relative inactivity of the uterus.

Valuable adjunct though the Crede expression has proved itself I seriously question whether in teaching it any harm would result if it were relegated strictly to the domain of pathological obstetrics at least let us insist that before it is attempted we have a good clinical picture of the detached placenta and let us impress upon ourselves and our internes that a Crede expression, attempted prematurely before the act of separation is complete is as fraught with consequences as the application of forceps to the incompletely dilated cervix, without exception carrying with it the possibility of creating a real alteration in the delicate mechanism of separation which in its turn brings us to a possible manual invasion of the uterus with its estimated mortality of 5 to 10 per cent. At St. Luke's we have been endeavoring for some time past to secure data upon the clinical phenomena of sepa-

ration of the normally situated placenta and its membranes particularly in so far as the time required the amount of blood lost but above all as to the necessity or non necessity of any and all uterine massage in the absence of hemorrhage.

My remarks this evening are only submitted in the nature of a preliminary report as I realize that the number of cases must be immeasurably greater than at the present time before any logical deduction may be drawn. Much difficulty has been encountered in measuring even approximately the amount of blood lost post partum. It has been our endeavor in the main to base our conclusion of the third stage in so far as practicable upon visual observation rather than manual. Immediately upon delivery the sterile towel is removed from the abdomen the patient's pulse is recorded we assure ourselves that the bladder is empty or nearly so as a distended bladder is not conducive to a physiologic third stage and the height and form of the uterus are ascertained as they may be in many cases visually. Or if this is impossible the sterile towel is replaced and these facts elicited by palpation. The woman from the time of delivery is most acutely observed for signs of hemorrhage and any free bleeding is combated with massage. Upon delivery the cord tape is placed lightly upon the cord at the vulva. When it has been determined that the placenta is detached the simple expression is practiced using the uterus as what has been described as the piston of a syringe. We believe the actual time of expression is of relatively little importance once the act of separation has been determined. Personally I have been arriving by easy stages to a technique based up on the above for the past three years. In so far as the series of cases upon which we are endeavoring to obtain accurate data relative to the clinical phenomena of separation are concerned I should like to remark that thus far we have been impressed with several facts: first the rapidity of separation where massage is not practiced; secondly the relatively slight amount of bleeding and the large percentage in which the fetal surface of the placenta presents as noted in an enormous series of cases by Pinard Ahfeld (4) and many other observers.

Bumm (5) has given us an unexcelled picture of separation of the placenta saying the change from the spherical elastic uterine form to the dome or cupola contour with its increased angularity the boggy mass palpable above the symphysis the uterus usually rising above the umbilicus inclining to the right. This picture with or without in advance of the cord plus an intermit-

tent sanguinous discharge is almost unmistakable.

While appreciating the difficulty of demonstrating it clinically I am convinced that massage of the uterus is occasionally responsible for a disturbance in the mechanism of separation and I feel that at the present time one sees if anything rather too much massage and uterine manipulation than too little.

Holzappel (6) quotes Levy in support of his contention that uterine massage is often productive of an altered mechanism as saying that in the Stuttgart Midwives School where the uterus is massaged irrespective of bleeding purely to promote uterine contraction and where the placenta is expressed by the Crede in thirty minutes after delivery that in a series of 624 cases there was retention of the membranes in 50 cases. I believe that it is not the Crede expression *per se* but an attempted Crede before separation that is productive of morbidity and yet how infrequently do we meet the interne or nurse unless especially instructed who is capable of assuring us of this fact from simple palpation of the fundus.

We have all observed the gush so frequently following an attempted Crede before detachment is complete and we can picture to ourselves the uterus at this time as so admirably depicted by Dohrn (7) in a state of marked inflection the partially thrombosed sinuses a forcible rupture of the retroplacental clot and tearing of the membranes an entirely different process than the gradual separation of the placenta by the wedge-like action of the placental clot. If we are to admit Fehling's (8) contention that bleeding ceases not from permanent contraction of the uterus but by a gradual thrombosis of the veins on the placental site extending from the retroplacental clot we must concede that massage should not only be light but should be practiced only to arrest free bleeding and not for the purpose of stimulating uterine contractions.

While I am not familiar from personal experience with the purely expectant plan of treatment as advocated by Ahfeld I believe that if compelled to choose between it and to say the least the rather dogmatic statement of a recent writer who to quote literally expresses himself as follows the placenta is to be expressed by the Crede method at the end of thirty minutes I should elect the method of Ahfeld and by so doing would have a lower morbidity. Winkler (9) in commenting upon a hundred cases from his own clinic where the average amount of blood lost was 305 grams remarks very pointedly: Aber hier ist weder von oben gedrückt noch

von unten gezogen. It is I believe generally conceded by all writers today that traction upon the cord is prone to produce a decided alteration in the normal mechanism of separation. Fehling has demonstrated to his own satisfaction that a cord around the neck must be 50 centimeters in length in order not to be liable to cause separation.

If in these remarks I have seemingly dwelt excessively upon the subject of massage it is because I sincerely believe that it is of vital importance. If uterine massage to promote contractions in the absence of hemorrhage is necessary our writers should tell us so and why. Massage under these conditions is either necessary or superfluous. I believe that the general tendency in Germany and in France particularly where the Crede has never had the vogue it enjoys here is toward less manual attention to the uterus. On the other hand our English writers seem to favor manual observation. Per-

sonally I believe in and practice the minimum of uterine manipulation particularly during the period immediately following delivery. In fact Farmer (10) has most aptly in my estimation covered this subject with the phrase: Surveillance constant, intervention insignifiante.

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# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNECOLOGICAL SOCIETY

JOINT SESSION CHICAGO GYNECOLOGICAL AND CHICAGO UROLOGICAL SOCIETIES DECEMBER 13, 1916

### SYMPOSIUM ON STERILITY

Papers were read by Dr. Louis E. Schmidt (p. 594) and Victor D. Lespinasse (p. 597) on Sterility in the Male and by Dr. Mark T. Goldstone on Sterility in the Female (p. 592).

### DISCUSSION

Dr. C. S. BACOV. This is such a large and complicated subject that it is impossible to take up all the phases. The question of what may be called ovarian sterility is rather interesting. We generally assume that if a woman menstruates she ovulates, but it does not necessarily follow that the ovum is in a condition for fertilization because menstruation occurs. It is possible that the ovum might not be set entirely free or if freed from the ovary it might not be set free here it would be fertilized. The cases in which a woman menstruates irregularly are important because it is important to know about what time she is most apt to become pregnant. According to the modern teaching ovulation occurs some two or three weeks before menstruation. If the menstruation is irregular and infrequent we can only inform the patient that according to what we now know the impregnation is most apt to occur about two weeks before the menstruation.

As to the question of treating sterility of course I assume that the question of male sterility has been answered always before any treatment of the woman is undertaken. If it is decided that the spermatozoa are present and in good condition it comes to the question of the treatment of the simple cases in which the spermatozoa probably do not enter the uterus. First there are the conditions of displacement of the uterus and the cases in which the serum is ejected from the vagina a large quantity before the passage of the sperm to the uterus can occur. In these cases it is of course always desirable to correct the displacement. In many instances the use of a pessary will overcome these displacements. In many women where the vaginal structure is lax the use of the knee chest position sometimes produces satisfactory results.

There are also the cases where a considerable cervical discharge is present with the rather constant presence of mucous fluid in the cervix. If that cervical catarrh can be satisfactorily treated

as it frequently can the results may be good and the sterility overcome.

There remain also the cases of a rather long cervix in which there is not any large amount of discharge, no particular catarrh and other conditions are apparently normal. In such cases the question arises as to enlarging the cervical opening or shortening the cervical canal. With a number of patients who remained sterile after rather prolonged treatment including unsatisfactory attempts to inject semen into the uterus I have had satisfactory results following the amputation of the long cervix.

Dr. HERMAN L. KAFTSCHMER. Two points have been brought out that I should like to discuss. In the investigation of each barren marriage the search should begin with the male and not with the female. Ultimately these patients drift to the genito-urinary man with the history that the woman has had operations without any results. Often patients bring in a specimen which shows absence of sperm. I think too much emphasis cannot be laid on this point.

This point brought out by Dr. Schmidt. Out of seventeen cases he had none in which he was sure he had a definite result. In a great many instances patients come with the plea that they be operated upon but we should be very careful in promising relief. Personally I have never performed the operation of anastomosis of the tubes because I think the chances of success are not more than 10 to 20 per cent.

Dr. THEODORE J. DOLDERLEIN. One important point has been overlooked and that is malposition of the uterus. In my series of cases there are many in which correction of the malposition by means of the pessary has been productive of good results. One of my patients has had two babies as a result of correcting the malposition by means of the pessary. Now she retains the malposition because she does not care for any other offspring.

In sterility of the male there is the secretion of hormones to be considered. This recalls a case which came under my care recently in which a man and woman came complaining of absence of offspring. I examined the woman and found no trouble and by questioning each I found that in the seven years of marriage the husband had never been able to have proper co-unction. He was a neurotic and I gave him three or four strychnine injections thinking that possibly by suggestion I

could do something. He came back much distressed. I happened to have some of Armour's ovarian extract in the office and gave him one injection of that. He came back in a few days and said he was quite successful. I gave him another injection and a month later he wrote me that his wife was pregnant. We all know that the ovarian and the testicular extract have the same action on the hormones of the genital organs. I think it makes no difference which we use.

DR CHARLES E. PADDOCK. I was impressed with the statement that the males should be examined first. We know that the large percentage of cases of sterility are due to the male and in my practice I am satisfied that it is more than 25 per cent. I wish to disagree with Dr Goldstone in his statement that he did not believe the extreme measures of opening the abdomen should be entertained. In a few cases, probably five or six, I have opened the abdomen where everything else had been tried and in two of the cases I found a closure of the tubes. There was no history of inflammation but the tubes were closed. So far as I know the operations did not result in pregnancy but it might be the cause of sterility.

I was much impressed with Dr Lespinasse's statement regarding the blood serum and think we shall hear more from this.

DR HAMER of Indianapolis. I am glad of the opportunity to be here on this occasion. I do not know that there is anything that I can add to this program on the subject of sterility but I should like to ask a question in reference to sterility in the male whether the observation has been made of sterility due to orchitis following mumps where no obstruction has been found, whether this condition can be corrected.

DR YARROS. I am grateful for the opportunity to learn something about the latest theories, courses and treatment of sterility in the male. I meet many women who have no children although they have apparently normal pelvic organs and I am constantly confronted with the question why they are sterile. The idea that the male is responsible in a large number of such cases is still a new idea to many of the profession and laity particularly. I have a good deal of difficulty in persuading my patients' husbands that that might be the case. One of the reasons I suppose is due to the fact that it is not an easy matter to secure the right kind of an examination especially is that the case with men of moderate means.

As to Dr Goldstone's paper I wish to say that I too have for years treated cases of sterility due to what we call simple infantile uterus by thorough dilatation and the introduction of a silver stem pessary which is left in the uterus for 3 or 4 months with splendid results. I have had quite a number of cases who had been married from 3 to 10 years who had given up the idea of ever having children and who became pregnant from several months to a year after this simple treatment.

DR N. S. HEANEY. The only remarks which I might care to make are regarding my negative results. In the first place, I dislike to treat patients complaining of sterility because they frequently are not sincere and refuse complete investigation. They are usually only mildly curious to know what may be the matter and if the wife is sincere and willing to go to some inconvenience then the husband may not be willing himself to be investigated.

I cannot really say that I have cured a case of sterility. Absolute sterility can be said only to exist when the tubes are closed or an absolute obstruction exists to prevent the meeting of the ovum and the spermatozoon. Since no case in which I have resected a closed tube has subsequently become pregnant. I cannot say that I have cured a case of sterility. I have operated upon a few patients by dilating the cervix or by incising the cervix, when these operations were indicated, and a few of these patients have become pregnant. Am I however in the light of the following to say these pregnancies resulted because of an operation? Recently we delivered a woman on our service at the hospital of her first child after having been married for 19 years and I now have on my waiting list a patient for delivery in February whom I was about to operate upon for a retrodisplacement of the uterus principally because of her desire to become pregnant after 9 years of sterile married life. She however missed a period just preceding her proposed entrance into the hospital so that I advised her to wait. She proved to be pregnant, and as I say is soon to be delivered. By a bit of luck she became pregnant before it could be attributed to any operative procedure. When we know of pregnancy occurring very frequently after long years of sterile married life how can we attribute any result to our operative procedures unless we have removed a definite absolute anatomical obstruction? Therefore I am rather pessimistic regarding many of the common procedures offered for the cure of sterility. How can one say that he obtains results?

DR GUSTAV KOLISCHER. That infection in the male *per se* does not prevent fecundation, is proved by the fact that there are plenty of cases on record in which a woman at the occasion of the first coitus was impregnated and at the same time infected with gonorrhea and syphilis.

In discussing sterility in women it becomes necessary to distinguish between conditions that are apt to make impregnation difficult or improbable and those that make impregnation absolutely impossible.

An abnormally short vagina and a hyperelastic fornix will make fecundation hard because the semen will be thrown out immediately after it is deposited. Cicatricial narrowing of the cervical canal may interfere with impregnation. Cicatricial tissue developing in the site of an infected trachelorrhaphy may form a barrier against the ascent of spermatozoa.

and so on. In this way it can be understood how change of position during cohabitation or a dilating of the cervix may lead to impregnation. And then there are conditions that make conception absolutely impossible: a woman with atresia of the vagina or the cervix or with complete occlusion of both tubes cannot possibly conceive until these conditions are remedied.

I fail to understand how serious objections can be raised against salpingostomy in appropriate cases. It is true that favorable results are obtained in a small minority of cases, only still in cases of complete bilateral tubal occlusion is the operation the only chance. I recall a case of a woman in which this operation placed the only infant exposed by her lips and the woman became pregnant.

In dealing with such a complex problem as that of sterility the gynecologist has to be as exact and accurate as possible and therefore I must take exception to some of the sweeping generalizations propounded by Dr. Clouston.

Fibroids do not materially interfere with impregnation because there are on record any number of cases of pregnancy complicated by myomata operated on or not and some delivered full term. Neither can I subscribe to the assertion that prostitutes do not become pregnant because all of them are infected. The latter is true but it is also true that young prostitutes, abortionists, professional and otherwise, are very busy.

I may add a statistical item to this point. Some thirty years ago when we started to practice one of the most popular gynecologic exercises, the indiscriminate removal of gonorrheal tubes and ovaries, we had a rush of prostitutes to our clinic because they all wanted to be sterilized.

I want to take a decided stand against the use of intrauterine pessaries. They were discarded a long time ago on account of the peril of infection, inflammation, eventually decubitus and perforation. Aseptic introduction of such an appliance does not insure against later infection.

It is hard to believe that the so-called malposition of the uterus are apt to interfere with impregnation. I account for the great number of pregnant retroflected uteri that arise with the progress of pregnancy or become impacted the latter instance occurring if a uterus tied down by firm adhesions becomes impregnated.

That as Dr. B. can point out the time of ovulation and menstruation has something to do with the successful coitus becomes very probable if one considers the fecundity of the unions in the reigning houses of Europe where the time of cohabitation is regulated after rules formed from empiric data.

Dr. Louis E. Schmidt (in closing). The most interesting type of sterility includes the cases in which the semen shows an absolute absence of spermatozoa and in which practically the entire semen is made up of amyloid bodies or in a differ-

ent type of leucithum. In a good many instances I have been able to watch the semen in patients who have come for treatment on account of lack of children. Examination has shown the semen to have spermatozoa in the abnormal quantities of amyloid bodies or leucithum. In other instances the semen shows an absence of spermatozoa and only either amyloid bodies or leucithum. Up to five years ago I was tempted to treat these cases as outlined in my paper. Every possible known remedy in clinical remedies of course I tried from the ductless glands was used and in the other hand attempts at stimulating the sexual glands were made even in some cases where the patient gave a history of gonorrhea. Here some complications following gonorrhea still exist but I have as yet to see such cases of non-pregnant. In cases in which there is a specimen of bungle in the semen and in which later there has been shown an absence of spermatozoa and in which the semen is made up of amyloid bodies or leucithum I am at a loss to suggest any satisfactory treatment. I consider these cases hopeless from therapeutic standpoint. I think it might be possible that some of the cases in which amyloid and leucithum bodies predominate might be of the obstructive type.

It might be combined with an obstructive type and that under those circumstances operative treatment might be some aid. Naturally in the operative treatment of the distinctly obstructive type the microscope should be at hand because when one attempts an anastomosis he should be on the lookout for spermatozoa. If no spermatozoa are found there is only a probability that anastomosis will bring success. In some cases I have done an anastomosis at two or three different places. I have not tried it in the head or tail or body of the epididymis but have done the anastomosis directly to the testicle and in some instances have found spermatozoa in the testicle but not in the epididymis. In this connection there is no objection to making numerous anastomoses with the vas and with the epididymis and with the testicle if necessary.

In the distal obstructive type there is of course hope in treatment and I believe Dr. Lespagnasse should receive great credit for the many improvements in the technique of the so-called original White operation. There is no question but that the more carefully the operation is carried out the greater will be the possibility of satisfactory results. From various anastomoses without careful microscopic observation at the time of operation and without the extensiveness which Dr. Lespagnasse has described the operation I believe are factors so far as the results are concerned. Lespagnasse stated that it was true that his own results might be called satisfactory but he has examined the literature and has found that surgeons who have done the operation perhaps thirty times report only four or five successful cases. If Dr. Lespagnasse reported eleven satisfactory results out of twelve he should receive great credit for his success which has undoubtedly been due to his careful technique.

Dr A. Strauss of the Michael Reese Hospital has carried out on the rabbit experimentally an anastomosis of the epididymis with the seminal vesicle. This means a complete transplantation into the pelvis of vas epididymis and testicle. He believes that such a procedure may be desirable only for certain cases and then only after explanation to the patient. He thinks no one at the present time would care to transplant a testicle into the pelvis unless further experimental work shows satisfactory results and no detrimental results.

Dr LESPINASSE (in closing). In regard to cases of one child sterility I wish to speak of a case just to show what one may encounter sometimes. In this case the man had been married and had a child and the wife had been married and had a child and then they had married each other and had no children. They both maintained that it was the fault of the other. There had been a period of three years in which the man had been a widower. Upon examination we found no spermatozoa in the husband's semen and found that this was due to an epididymitis when he was a widower.

In regard to the mumps this is sometimes almost a pure involvement of the testicle and sometimes of the epididymis and sometimes is a mixture of the two and these facts have considerable reference to sterility.

A couple were married and the wife was pregnant three months when the husband had a bilateral testicular mumps. As a sequella of the disease he had one testicle completely atrophied and the other had a mass in the epididymis. The pregnancy aborted at four months and four months afterward she became pregnant again and went on to full term. This baby died soon after birth but there has been no pregnancy since. The husband came for advice two years after this pregnancy. The examination showed absence of spermatozoa in his semen and further examination showed that the nodule was sensitive at times the testicle would hurt for a day or two and then the discomfort would disappear to recur at irregular intervals. When I examined him the nodule was rather hard. My interpretation of this case is that immediately after the disease he

had had no obstruction, the epididymis was still open, and the sperm could get through. Later as the scar tissue contracted more and more it had shut off the duct of the epididymis and rendered the man absolutely sterile.

The relation of gonorrhoea to sterility is something that is rather hard to answer. I consider most of the obstruction cases as sequelae of gonorrhoea and believe that gonorrhoea can produce sterility either by its own pus destroying the vitality of the sperm or indirectly by producing disease in the wife and in that way causing sterility. I include an examination as to sterility in my pre marriage examination.

Dr GOLDSTINE (in closing). I do not know whether Dr Kolischer misunderstood me or not, but I do know that not a member of the Gynecological Society would say that a fibroid would always cause sterility. I have seen as many pregnancies with fibroids as he has and delivered as many babies from women whose uteri contained fibroids but I still maintain that fibroids do at times cause sterility and I have had such women and expect to see others sterile because of fibroids in the uterus.

As regards infection in prostitutes I have never seen a prostitute who was not infected. I do not know about prostitutes elsewhere but in Chicago they do not come for treatment until they are seriously in need of it.

In treatment by the silver tube the results are very favorable. So far as I know there has been very little infection from these tubes if they are put in properly. I have never had a single tube where sloughing through the uterus into the bladder has occurred.

I do not think it wise to advise operation where the tubes are sealed or because operations on such tubes have not given results. If that pathology is present they cannot be relieved. While a laparotomy is not always dangerous yet occasionally a patient does die and even in a simple laparotomy the patient may be left in a much worse condition than before such operation. If it becomes a stand ard treatment I shall be glad to accept it.



# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN SURGERY

WITHIN the month an unusually astute literary critic after characterizing Jack London's *The Call of the Wild* as a brevet for immortality added that he would rather be known as the author of that book than of any other piece of American prose of the last half century. The expression of this sentiment called to mind Cullen's book on the umbilicus for the reason that any surgeon might well feel to value this book as the aforesaid critic felt about London's story. Personally I know of no other American treatise that even approaches this work in either method or scope. One picks up the volume with an almost inevitable harking back to the tale of the old German philologist who on his death bed expressed deep regret that he had not devoted his life to the possessive pronoun *his*. And yet in spite of the exquisite narrowness of his field Cullen has covered it in such fashion as to furnish an atmosphere of almost limitless breadth. He makes one feel this before finishing the first paragraph of the preface. This preface by the way stands as a model of what an introduction to a volume ought to be. It furnishes the reader with the central impulse that served as the goad for writing the book, outlines the methods pursued, the difficulties encountered and in astonishingly brief compass summarizes the meat of the data.

There are well over six hundred pages of text devoted to thirty-nine necessarily short chapters which chapters treat their respective subjects in an almost inconceivably detailed fashion. This statement alone emphasizes the hopelessness of the reviewer attempting anything like a critically constructive review. As it happens the reviewer has had occasion to dip pretty deeply into the literature of the umbilicus and is therefore in a position both to second all that Cullen has to say about the accuracy of at least a good number of the literary citations and to marvel at the depth of theme he has opened.

Perfunctory as such a procedure may seem the only rational hope of putting readers in touch with the volume lies in furnishing them with the time-worn synopsis of the table of contents. The embryology and anatomy of the umbilicus are treated in two chapters that are so full of remarkable illustrations as to command and fix both attention and admiration. There then follow chapters on Umbilical Infections of the New Born, Umbilical

Hemorrhage, Granuloma of the Umbilicus, Remnant of the Omphalomesenteric Duct, Congenital Polyps, Meckel's Diverticulum, Intestinal Cysts, Patent Omphalomesenteric Duct and the consequences thereof, Subumbilical Abscess, Paget's Disease, Diphtheria of the Umbilicus, Intra-abdominal Abscesses Opening through the Umbilicus, Fecal Fistulae at the Umbilicus, Tumors of the Umbilicus, Umbilical Hernia, the Urachus, Congenital Patent Urachus, Urachal Remnants and Resultant Tumors Occurring between Symphysis and Umbilicus, Large Urachal Cysts, Abscess and Cavities, Acquired Urinary Fistulae at the Umbilicus, Urachal Concretions and Calculi, Malignant Changes in the Urachus, Bleeding from the Urachus into the Bladder, Tuberculosis of the Patent Urachus.

After an unwarrantably close search it was not possible to find anything in the book to which exception could be taken. One might legitimately object to Cullen's suggestion that papillomata of the umbilicus be classed among the connective tissue group of tumors because such an innovation in classification leads only to confusion, but to pick out a triviality of this type is a close kin to carping criticism.

As a type of book making the treatise is a model. Paging, type, paper and above all the illustrations superb in quality and reproduction make the volume a holiday gift book. M. G. S.

TO the oft repeated assertion that American medical books serve only to separate the busy practitioner from his surplus funds comes a splendid answer in Deaver and McFarland's new book on the breast. It is not only a record of personal observations and achievements but a compilation and critique almost encyclopedic in its extent of the entire body of our knowledge concerning anomalies and diseases of the breast. It is the result of the combined efforts of the surgeon, the pathologist and of Dr. J. Leon Herman without whose indefatigable labors this book would not now be existing, a result which emphasizes anew that only through such co-operation can completeness be approximated in a work of its kind.

Two chapters on congenital and acquired anomalies of the breast each covering more than fifty large octavo pages follow the introductory chapters on the normal breast and its surgical

Embryology, Anatomy and Diseases of the Umbilicus, Together with Diseases of the Urachus. By Thomas S. Cullen, M.D., Philadelphia and London: W. B. Saunders Company.

THE BREAST: ITS ANOMALIES, ITS DISEASES AND THEIR TREATMENT. By John B. Deaver, M.D., LL.D., Sc.D., and Joseph McFarland, M.D., Sc.D., with J. Leon Herman, B.S., M.D., Ph.D. Philadelphia: F. B. Roth, Inc. and Co., 1911.

anatomy seem at first glance unduly long but they are done with the thoroughness that characterizes the entire book. They include tabulations and numerous illustrations of cases of polythelia, mammary hypertrophy and gynecomastia and a bibliography that though it cost many dreary hours of library research yet has furnished so many interesting additions as to make the present writing the greatest collection of cases ever brought together.

The chapter on infectious diseases of the breast opens this section of the book. A discussion of puerperal mastitis with a detailed description of various methods of treatment, is followed by a brief description of the less common forms and by a detailed discussion of tuberculosis and actinomycosis, with summaries of cases reported in the literature, and a briefer discussion of syphilis and sporotrichosis.

From the confusing list of terms used to distinguish cystic disease of the breast the authors have chosen Warren's term, abnormal involution, as most accurately describing the condition and under this head group 148 of the 575 cases forming the basis of their pathological studies. These have been classified according to the pathological findings into a number of subgroups all of them depending however upon the presence of cystic change as the chief evidence of disease. Of this type of breast pathology there are no absolute diagnostic criteria aside from microscopic examination nor are there any symptoms by which the proliferative types which tend to go on to malignancy can be distinguished from the simple type. The authors emphasize therefore the importance of exploratory operation in the presence of cystic disease with excision of the suspected areas and immediate examination of frozen sections. On the other hand they decry the panicky tendency toward radical operation in the presence of every growth in the breast and cite Bloodgood's series of 100 successful cases following partial operation and Greenough and Simmons' series of 83 cases with 80 per cent of cures. Surgical science they conclude, must be in a very inexact stage when we are able to get together the results of pathological examination of 45 breasts of which only 4 showed mild adenocystic change, and only 7 epithelial proliferation into cystic spaces while 34 were entirely benign cases of normal or senile involution.

Tumors of the breast naturally receive the lion's share of attention. The benign tumors and sarcoma are grouped under non-indigenous tumors of the breast carcinoma occupies a pedestal by itself. That the benign fibro-epithelial tumors constitute only 23.7 per cent of all mammary tumors according to clinical statistics from the records of the German Hospital and from 12 per cent (70 of 575 cases submitted to McFarland) to 17 per cent (Roodman) according to other statistics emphasizes anew with what seriousness every tumor of the breast must be regarded. That the age incidence

of benign tumors is lower than that of malignant tumors is unquestioned nevertheless one of every seven women under 30 years of age with a tumor of the breast was found to be suffering from carcinoma. As to the treatment of benign tumors the authors feel that the presence of a growth in the breast is an indication for operation in the absence of grave systemic disease. Simple excision, plastic resection according to Warren's method or subcutaneous amputation may be employed depending on the location and extent of involvement. That the appearance of a tumor is an indication of the susceptibility of the entire breast to the formation of neoplasms is the final note of warning with reference to benign tumors.

The subject of cancer calls forth the prefatory remarks that the critical examination of the results of any large series of cases cannot but produce a profound impression and lead to the distressing realization of the fact that we as a profession are far from the scientific application of much of the knowledge at our disposal and of approximately 1000 breast cases at our disposal we have been able to keep a sufficient number of operative cases under observation to learn that we have established no high water mark in the cure of malignant disease of the breast we cannot even lay claim to as great success as has been claimed by some of our contemporaries. The entire subject of cancer is taken up with a splendid thoroughness of detail. The microscopic anatomy the theories as to the mechanism of metastasis the time and favored routes of metastasis, the striking tendency to secondary liver and bone involvement are discussed at length. With regard to regional metastases the authors found only 6.5 per cent of malignant cases with enlarged axillary lymph nodes in which the microscope proved the absence of cancer cells. On the other hand in 62 per cent in which no cancerous glands were palpable, the microscope showed involvement of these structures. Kuester's series is also mentioned in which only 2 of 117 cases were free from axillary metastases. As to the time of metastasis no definite statement is made except that local dissemination undoubtedly takes place in the very early stages. Fink is quoted as saying that the axillary lymph nodes become involved as early as the sixth month and after the thirteenth month are invariably invaded.

A careful analysis has been made of postoperative statistics from the authors and other series. Of their series of 506 operative cases the authors were able to trace 150 operated upon three years or longer before. Of these 34 per cent were well three years after the operation, and 26 per cent five years after the operation. Further improvement they feel must come from education of the public, from earlier recognition of the disease by the physician, and from earlier operation. That the duration of the disease before operation averages 30 months is a serious reflection upon the entire medical profession.

The anxious types of radical operation are fully described with numerous illustrations. Dr Pfahler contributes an interesting chapter on the non-operative treatment of cancer with a series of case reports showing the results of Roentgen ray treatment. A chapter on diseases of the nipple and areola closes the book.

Dr Deaver and Dr McFarland deserve unstinted credit for the performance of a real task conceived in a big way and well done. Their book will command attention for years to come. S. L. K.

TO the surgeon of today with the facilities of an up to date hospital at his disposal a glimpse of the hand caps under which his predecessors worked only forty years ago makes him realize anew how great is his debt to those who are gone before. Dr Fluhrer's book is interesting not only for its discussion of the principles of the treatment of fractures but also for its glimpse of hospital conditions in New York in the seventies and eighties. That he never saw a healthy open wound for the year and half while he was interne of Bellevue Hospital today seems almost incredible. His account of his early battle against hospital infection at the Park Reception Hospital is especially interesting. In Bellevue the floors had been washed and the bedding changed frequently enough but the walls of the ward had not been washed, then recollection. At his next post of duty the building was

an old one and there were many cracks in the walls. Under his own (the writer's) supervision the walls were thoroughly washed with soap and water the ceilings were whitewashed and the cracks in the walls injected with a 5 per cent solution of carbolic acid. This plan of procedure was carried out as a matter of routine thereafter with the result that during the next two years though the hospital was more crowded with open wounds than ever before not a single case of septicæmia or pyæmia occurred. Will o' successors look back forty years hence and wonder that some such obviously simple yet all important measure in the checking of contagious disease was left so long unthought of? S. L. K.

THIS volume<sup>3</sup> has the same degree of excellence which the former volumes have shown. Perhaps of all the points in the book that relating to the roentgen diagnosis as illustrated by several excellent plates is the most striking. There are however many exceedingly good articles such as that on the anatomy of the spinal cord and the anatomy of the stomach. Many articles are quite modern such for instance as that on anterior poliomyelitis and one on radiotherapy. Others such as those on peritonitis plague poisonous plants plastic surgery the prostate puerperal infection sarcoma sewage disposal shock and smallpox are well worth reading. C. G. G.

AN LAYMAN INTO THE PRINCIPLES OF TREATMENT OF BROMISM. Loomis. Philadelphia: Scott & Emme with Scientific Notes. By William F. Flaherty M.D. New York: The Rabson Company. 916.

REFERENCE HANDBOOK OF THE MEDICAL SCIENCES Embracing the Five Branches of Medicine and Physical Medicine and Allied Sciences. Vol. VI. Part Two. New York: William Wood & Co. 917.

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

TEXTBOOK OF SURGICAL OPERATIONS. Illustrated by Clinical Observations for physicians and students. By Prof. Victor Krause and Emil Heymann M.D. Translated into English and edited for American readers by Albert Ehrenfried A.B. M.D. I.A.C.S. Six volumes. Vol. II. New York: Reberman Company. 917.

HANDBOOK OF SUGGESTIVE THERAPEUTICS APPLIED HYPNOTISM PSYCHIC SCIENCE. A manual of practical psychotherapy designed especially for the practitioner of medicine surgery and dentistry. 4th ed. revised and enlarged. By Henry S. Munro M.D. St. Louis: C.V. Mosby Co. 919.

TRAUMATIC SURGERY. By John J. Moorhead B.S. M.D. F.A.C.S. Philadelphia and London: W.B. Saunders Co. 917.

NEW AND NON-OFFICIAL REMEDIES. 917 containing descriptions of the articles which have been accepted by the Council on Pharmacy and Chemistry of the American Medical Association prior to January. 917. Chicago: American Medical Association. 917.

REPORTS OF THE COUNCIL ON PHARMACY AND CHEMISTRY for 916. Chicago: American Medical Association. 917.

ANATOMICAL NAMES ESPECIALLY THE BABILE NOMINA ANATOMICA (BNA). By Albert Chauncey Eyles, M.D. B.S. Ph.D. M.D. assisted by Daniel Martin Schoemaker B.S. M.D. With biographical sketches by Roy Lee Mood A.B. Ph.D. New York: William Wood & Company. 917.

# Clinical Congress of Surgeons of North America

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EIGHTH ANNUAL SESSION

NEW YORK CITY

OCTOBER 22 TO 27 1917

## NEW YORK COMMITTEE ON ARRANGEMENTS

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JAMES T MCKERNON  
WILLY MEYER  
SETH M MILLIKEN  
A A MOSCHCOWITZ  
WENDELL C PHILLIPS  
JOHN O POLAK  
EUGENE H POOL  
JOHN ROGERS  
THOMAS A SMITH  
F E SONDERM  
J BENTLEY SQUIER  
GEORGE D STEWART  
W E STUDDIFORD  
RAYMOND P SULLIVAN  
PARKER SYMS  
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# CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA

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## PRELIMINARY PLANS FOR THE NEW YORK MEETING

UNDER the leadership of Dr Charles H Peck who was elected Chairman of the Committee on Arrangements at the annual meeting held on the afternoon of Thursday October 26 1916 in Philadelphia the clinicians of New York City and Brooklyn have organized a Committee on Arrangements to undertake the work of preparing a program of clinics and demonstrations for the eighth annual session of the Clinical Congress of Surgeons of North America to be held in New York City during the week of October 22 1917. The names of the members of this committee will be found on the opposite page.

Those surgeons who were privileged to attend the third session of the Congress held in New York City in November 1912 will recall the splendid program of clinics offered by the surgeons of New York City and Brooklyn at that time and will look forward with interest to a second opportunity of visiting these clinics. It may be confidently assumed at the beginning that New York and Brooklyn with their numerous large hospitals and well organized clinical facilities will be able to provide a program of unusual interest.

Clinicians at the following hospitals have signified their intention of co-operating in the clinical program and it is expected that a provisional program of clinics and demonstrations will be published in the next issue of this journal.

### NEW YORK CITY

Babes	Vemonal
Bellevue	Metropolitan
Beth Israel	Mount Sinai
City	Neurological Institute
Columbus	Eye and Ear Infirmary
Flower	New York
Fordham	Infirmary for Women
French	and Children
German	Park
Gouverneur	Philanthropen
Hahnemann	Poly clinic
Harlem	Post Graduate
Deformities and	Presbyterian
Joint Diseases	Rocketteller Institute
Ruptured and	Roosevelt
Crippled	St Francis
Hudson Street	St Luke's
Har Monah	St Mark's
Krueckerbocker	St Mary's
Lebanon	St Vincent's
Lincoln	Sloane
Lying In	Throat Nose and Lung
Manhattan Eye Ear	Vanderbilt Clinic
and Throat	Willard Parker
Manhattan Maternity	Women's

### BROOKLYN

Bethany Deaconess	Kings County
Brooklyn	Long Island College
Coney Island	Methodist Episcopal
Cumberland Street	Norwegian
German	St Catherine's
Greenpoint	St Mary's
Jewish	Trinity
Holy Family	Williamsburg

Clinical demonstrations at the following medical schools will also be included in the program:  
 College of Physicians and Surgeons  
 Cornell University Medical School  
 University and Bellevue Hospital Medical College  
 Fordham University School of Medicine  
 Long Island College Hospital  
 New York Homeopathic Medical College  
 New York Medical College and Hospital for Women  
 New York Polyclinic Medical School  
 New York Post Graduate Medical School

#### GENERAL PLAN OF THE MEETING

The Executive Committee of the Congress is in a position to make the following announcement as regards the general plan for the New York meeting. Headquarters will be established at the Waldorf Astoria where the Ball Room, Green Room, Waldorf Apartments and adjacent foyers and other rooms on the second floor of the hotel have been reserved for the use of the Congress. These rooms provide ample space for registration and ticket bureaus, bulletin boards, etc., the Ball Room being used for the evening meetings.

The program for the week will include clinical demonstrations, operative and non-operative in every department of surgery, gynecology, obstetrics, genito-urinary surgery, orthopedics, roentgenology, surgical pathology, surgery of the eye, ear, nose and throat. Clinical demonstrations at the hospitals and medical school will occupy the hours from 9 to 5 of each day, and the evenings will be devoted to sessions at which papers dealing with subjects of present day importance will be read and discussed by surgeons who have been selected because of their special fitness to discuss the subjects under consideration. This part of the week's program is now being arranged by the Executive Committee.

The presidential meeting at which the President Elect, Dr. John G. Clark of Philadelphia, will deliver the annual address will be held on Monday evening in the Ball Room of the Waldorf Astoria. On Tuesday, Wednesday and Thursday evenings there will be sessions of the section on general surgery in the Ball Room and on the same evenings in another room at the same hotel separate meetings for the section on surgery of the eye, ear, nose and throat will be arranged for

#### ANTI-FEE SPLITTING PLEDGE

A new requirement as regards membership in the Congress goes into effect at this meeting in

accordance with the following resolution adopted at the Philadelphia meeting and each member upon making advance registration will be expected to sign a pledge in accordance therewith:

Be it resolved: First that the Executive Committee of the Clinical Congress of Surgeons of North America is instructed to provide that hereafter the clinics of the Congress shall be open only to those surgeons who in their respective practice and in intent are opposed to the division of fees. Second that the meaning of the division of fees be interpreted in substance as follows:

I hereby declare that I do not and that I will not engage in the practice of the division of fees under any guise whatever that I neither collect fees for others referring patients to me nor permit others to collect fees for me nor make joint fees with physicians or surgeons referring patients to me for operation or consultation nor will I knowingly permit my agent or associate of mine to do so.

#### LIMITED ATTENDANCE

The popularity of these clinical meetings has proved so great that the plan of limiting the attendance and requiring advance registration which has worked satisfactorily at the last three sessions has been adopted as a rule for all subsequent meetings of the Congress. A survey of the operating amphitheaters, lecture rooms and laboratories in the hospitals and medical schools as to their capacity for accommodating visiting surgeons will be made and the limit of attendance will be based thereon. This plan insures accommodation at the clinics for each one who receives a membership card. In addition attendance at all clinics and demonstrations will be controlled by means of special tickets, the number of tickets for any one clinic being limited to the ascertained capacity of the room in which the clinic is given. Within a few weeks a formal announcement of the plans for the New York meeting, together with an invitation will be sent to all members of the Congress and advance registrations will then be accepted in the order of their receipt up to the limit of attendance to be fixed.

The Constitution of the Congress provides that a registration fee shall be required of each member attending an annual meeting, there being no annual dues for members of the Congress. The registration fee provides funds to meet the expenses of preparing for and conducting the annual meetings so that no financial burden is imposed upon members of the profession in the city entertaining the Congress.

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXIV

JUNE 1917

NUMBER 6

## TRANSPLANTATION OF THE URETER FOLLOWING TRAUMATISM AND RESECTION OF THE BLADDER FOR CANCER<sup>1</sup>

By EDWARD STARR JUDD M.D. ROCHESTER MINNESOTA

URETERAL fistulae have occurred following traumatism and following operative procedure. Removal of the kidney to which the damaged ureter belongs has not been at all unusual in the past. And this procedure will continue to be the best method of treatment for those cases in which a considerable part of the ureter is involved so that transplantation to the bladder cannot be performed. Before the kidney with the damaged ureter can be removed it must be demonstrated that the remaining kidney is functionally sufficient. The principal indications for ureterocystotomy have been threefold: (1) injury to the ureter during hysterectomy usually for advanced carcinoma of the cervix; (2) resection of the bladder for cancer located about the ureteral orifice; and (3) traumatism of the lower end of the ureter during difficult instrumental labor. Long (1) reports successful transplantation of both ureters following an hysterectomy for cancer of the cervix with involvement of the base of the bladder. He gives also the important features in the technique. Paton (2) reports successful transplantation of the ureter on account of traumatism which occurred during an operation for cancer of the cervix and resulted in ureterovaginal fistula. Torrance (3) reports a case of transplantation of the ureter from the vagina to the bladder 20 months

after a Wertheim hysterectomy. He buried the ureter for some distance in a trough of bladder wall. His case is especially important because he demonstrated that the ureter was patent and functioning two months after the operation. In a case of difficult labor at the Lying in Hospital, New York, Markoe (4) transplanted the lower end of the ureter to the bladder and obtained a good result. Kelly and Burnam (5) state that a ureterovaginal fistula following labor is not uncommon though they do not mention having operated on cases of this nature. Kelly reports one case of double ureterovaginal fistula in which operating through a vaginal incision, he obtained a good result by turning both ureters into the bladder.

We have performed ureterocystotomy (1) in two instances for ureterovaginal fistula following hysterectomy, (2) on two occasions for ureterovaginal fistula following labor, and (3) in 17 cases in conjunction with resection of the lower end of the ureter and a quadrant of the bladder for cancer.

CASE 1 (102891). A woman 41 years of age had had a hysterectomy performed elsewhere. The history showed that clamps had been left on and a gauze pack put into the vagina, and that urine had come into the vagina very soon after the clamps and pack were removed. Five months afterward we transplanted the ureter which was dilated to about twice its normal size showing that there had been some obstruction.

<sup>1</sup> Presented before the Southern Surgical and Gynecological Association at Hot Springs, S. C., December 1916.



**CASE 2 (144658)** A woman 43 years of age had had a very difficult abdominal hysterectomy performed in our clinic in February 1916. In this instance the ureter had been apparently partly tied off as we suspected at the time of the hysterectomy and a fistula had resulted. Shortly after the hysterectomy we made an effort to pass a catheter and found that the ureter was not patulous. At the time we operated to transplant the ureter we found it dilated to about twice normal size and there was much scar tissue at the ureterovaginal junction.

In both instances in which fistula followed hysterectomy the ureter was transplanted without much difficulty and the wound healed primarily. Cystoscopic examination made about three weeks after each operation showed that the ureters were open and that urine was coming into the bladder through them. Recent reports from these patients state that both have remained well. In one instance 20 months and in the other 8 months have elapsed since the transplantation of the ureter.

The two cases in which ureterovaginal fistulae developed following labor were of especial interest to us because of the rarity of the condition. They are the only two cases of the kind that we have seen. In talking with Dr. Markoe who has had a very large obstetrical experience in the Lying in Hospital of New York, he stated that his case mentioned above was the only one that he had seen.

**CASE 3 (130856)** A woman 9 years of age had gone through a very difficult labor three years previously. Six months after childbirth he had been operated on for vesicovaginal fistula and had obtained partial relief. Late she was again operated on by abdominal incision but obtained no further relief. At the time she consulted us examination showed that she passed about half her urine the normal way and had perfect control of it. In spite of this however her clothing was continually soiled by urine which leaked to the vulva. Cystoscopic examination did not reveal an artificial opening into the bladder and urethral catheters could be passed into both ureters without obstruction. However with a vaginal speculum a small opening could be seen in the right side of the vagina just above the base of the bladder from which urine was draining. A catheter was put into the right ureter and the urine drained through it for a number of days. Meanwhile there was no evidence of leakage through the fistula. Since the opening was so small and it was found possible to control the urine by urethral catheter it was thought that freshening the

edges of the fistula through the vagina and placing a few stitches across the opening would probably close the fistula. We attempted to do this and left a urethral catheter in place for ten days. During this period there was no leakage but just as soon as the catheter was removed the urine drained into the vagina as it had previously. An abdominal extraperitoneal incision was then made. The ureter was freed down to the bladder and the lower segment tied off. The upper segment was transplanted into the bladder wall. Since her labor the patient had had several attacks of what appeared to be pyelitis accompanied by chills and fever. She had had pain in the region of the right kidney. Ten days after the ureter was transplanted she had a similar attack and for a few days urine drained through the abdominal wound. However at the end of four weeks her wound was entirely healed. Her temperature and pulse had been normal for some time. Cystoscopic examination showed that the ureter was functioning although at times there was considerable pus in the urine which came down from the right kidney. I operated on this patient in August 1915. In a recent letter she says that since the transplantation of the ureter she has had no further attacks of chills and fever and has remained entirely well.

**CASE 4 (143563)** A woman 27 years of age came with a ureterovaginal fistula complicated by a vesicovaginal fistula which had been operated on twice before we examined her. Although transplantation of the ureter performed April 1, 1916 improved her condition considerably the last time she was seen there was still slight leakage from the vesicovaginal fistula. At this time she was about 3 months pregnant. A few weeks ago we received a report from her in which she stated that leakage of urine had almost entirely ceased and her condition had improved.

In the 17 cases of cancer of the bladder very satisfactory results were obtained by transplantation of one or both ureters. Many of these patients were operated on for very extensive cancers of the bladder some of them have since died of a recurrence. We have been able to trace other patients for several years and during that time have examined them repeatedly with the cystoscope. In one instance 3 years after the operation the ureter was functioning very well. In a few cases during cystoscopic examination we observed that the urine flowed from the transplanted ureter into the bladder almost continuously rather than by spurts as under normal conditions. In other instances the urine seemed to enter the bladder normally. It is probable that the continuous flow of urine was the result of a chronically infected

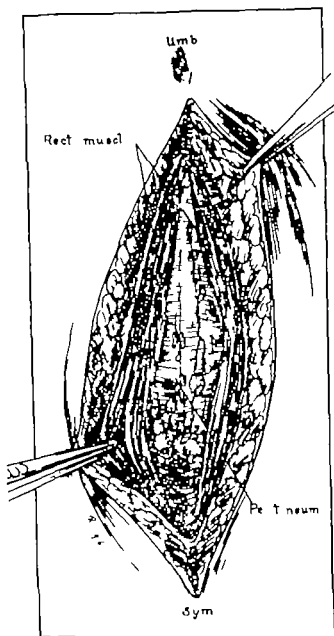


Fig 1 Regular suprapubic incision with recti muscles cut. Bladder still in place

ureter in which peristaltic contractions could not take place because of the thickened walls. In none of the cases was there a permanent urinary fistula, though there may have been small amounts of leakage for short periods.

In every instance in which we have been able to make a cystoscopic examination at any time after the transplantation of a ureter we have found the ureter open. In a few cases it could not be catheterized although the urine was coming through it into the bladder. It seems entirely probable that a stricture might form and close the ureter completely, but as far as we have been able to determine

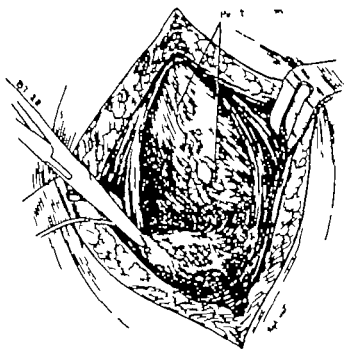


Fig 2 Peritoneum and fat dissected from top of bladder

this has not occurred in our cases except possibly in one case of cancer. However, in the case in which the ureter was practically ligated at the time the hysterectomy was performed, very little urine had been coming down from the ureter for two weeks previous to the ureterocystostomy. We were in doubt as to whether there would be a great deal of function in the kidney as the ureter had been ligated so long. A few weeks after transplantation of the ureter, a functional test of the kidney was made. Although there was some function on the traumatized side, about five-sixths of the return was through the normal kidney. In this connection I may also mention two cases in which one ureter was deliberately ligated at the time of the operation for resection of a part of the bladder for cancer. The ureter was ligated because it was impossible to make it reach to the bladder, and since the operation had already been extensive, it did not seem advisable to transplant the ureter into the intestine. In both instances the ureter was considerably dilated and evidently had been obstructed by the growth for some time. The ureter was ligated with the idea of doing a nephrectomy later if advisable, but in neither case was nephrectomy necessary, nor was any difficulty apparent from this procedure. Both patients

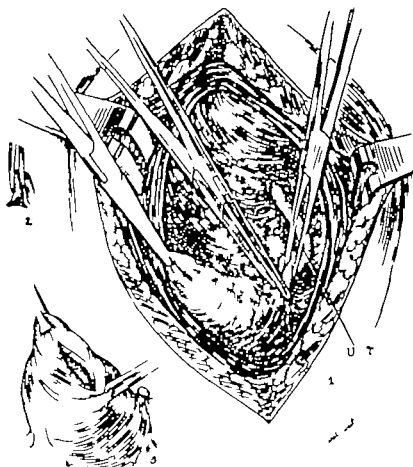


Fig. 3. From 4 to 6 inches of ureter dissected out and clamped in place prior to cutting out end of ureter which is to be transplanted & bladder opened and ready for transplantation of ureter.

were operated on more than a year ago and are alive at the present time. One has a recurrence in the bladder and a urinary fistula has developed from the bladder in the suprapubic wound which remained closed for a number of months after the operation. In neither case have we been able to palpate the kidneys at any time.

#### TECHNIQUE

The same technique was used in all of the traumatic cases. A straight rectus incision was made from the symphysis almost to the umbilicus (Fig. 1). The peritoneum was dissected back and the ureter exposed (Fig. 2). In one instance the peritoneum was opened. The ureter was liberated as far down toward the bladder as possible. In

each instance there was considerable scar tissue and the dissection was continued into it (Fig. 3). The ureter was divided between clamps and the lower end ligated with plain catgut. The ureter was liberated from its bed sufficiently to make the anastomosis into the bladder free from tension. In each instance the choice of the region in the bladder for transplantation depended on the amount of freedom from tension that could be obtained. The end of the ureter was split for a short distance and a small opening made into the bladder. We think it is essential that the end of the ureter should project into the bladder for a short distance. In order to hold the ureter in place each of the two parts of the split ureter was stitched by a plain catgut suture to the mucosa of the bladder.



Fig. 4. 1 Interrupted suture placed on the ends of the transplanted ureter 2 starting to close bladder 3 bladder closed with ureter in place

(Fig. 4) The coats of the bladder were then accurately stitched around the ureter. We endeavored to pass the ureter obliquely through the muscular walls of the bladder so that it would simulate the normal course. We never use anything but plain catgut for the sutures inside the bladder. Fine chromic catgut is used to stitch the ureter to the surrounding structures (Fig. 5). Usually there was a little soiling from urine during the operation, and in each instance a small drain was placed in the wound. In resections of the bladder for cancer the transperitoneal method suggested by C. H. Mayo was employed. This technique is safer and more accurate for these cases because the peritoneum can be carried with the ureter and the peritoneal covering of the bladder makes an accurate closure. In the cases in which the transperitoneal method was used the wound healed primarily and none of the patients had any urinary leakage.

Since 1908, we have performed intravesical transplantation of one of the ureters in 17 patients suffering from carcinoma of the bladder. Thirteen of these patients were males and 4 were females. The average age was between 54 and 55 years; the oldest patient was 67 and the youngest 33 years of age. The average duration of symptoms was  $1\frac{1}{2}$  years; the longest history was 5 years and the shortest 2 weeks. In each instance with the aid of the cystoscope a clinical diagnosis of malignancy of the bladder was made; the surgical diagnosis was carcinoma and the pathologist's report substantiated these opinions.

From one third to two thirds of the bladder was resected and the ureter transplanted into the remaining portion. Three of the 17

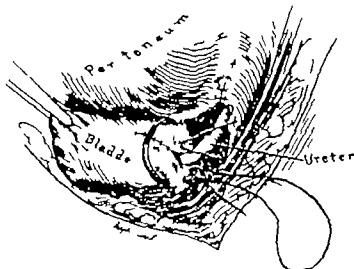


Fig. 5. Drawing tissues around ureter and bladder to hold ureter in place

patients died in the hospital, an operative mortality of 18 per cent. One lived 5 days, one, 6 days and one 23 days. Necropsy showed that the patient who lived 5 days had an acute nephritis of the right kidney (left ureter had been transplanted) and left hydro-nephrosis. The second patient died on the sixth day from toxæmia from extravasated urine. The third death at 23 days was due to an acute nephritis superimposed on the chronic condition. In this instance the right ureter had been transplanted and at necropsy it was found that it had been obstructed. There was a blood clot in the ureter and in the pelvis of the right kidney. This patient also had a marked arteriosclerosis. Light of the patients who survived the operation have since died. The average length of life was 2 years and 1 month. One patient lived 7 years.

Patient 5756 lived 3 years and 9 months after transplantation of the ureter. His physician wrote us that death was due to carcinoma of the stomach. This patient had returned to our clinic 9 months previously at which time his general health was fair. His prostate was very hard and firm, his inguinal glands hard, and his legs swollen.

Patient 3326 lived 1 year and 5 months. He gained in weight and strength for seven months following the operation but died from recurrence.

Patient 24745 lived 7 years. He gained 40 pounds in the 3 years directly following the operation. His physician wrote that death was due to heart failure.

Patient 34725 improved slightly but died in 2 months.

Patient 48717 lived 2 years and 1 month. He

returned for examination 7 months after resection of the bladder and transplantation of the ureter. There was a recurrence of the carcinoma in the bladder including the area into which the ureter had been transplanted. The transplanted ureter was not visible. The area was cauterized with a high frequency current. The patient returned 5 months later and the high frequency current was again applied. His last visit was 18 months after the first operation and at that time we explored the bladder but found the condition inoperable.

Patient 86767 lived 1 year after the operation. In the meantime his symptoms had returned. One month before his death he came back to the clinic and we operated for the recurrence in the bladder and for stones. He died on the twelfth day following the operation.

Patient 92613 lived 6 months after the operation. For 3 months after the operation he gained in weight and strength.

Patient 90860 lived 5 months after the operation. At the time of the resection the carcinoma was broad based and very extensive. Half of the bladder was resected. His general strength improved following the operation but he died of a recurrence in the bladder.

We know that five of the remaining six patients are alive at the present time. We have been unable to obtain a recent reply from the other patient who was operated on in 1913 but when last heard from he was in good condition. The following are short reports of the condition of patients still living.

Patient 42568 wrote us 6 years after the operation that he was in good condition and had gained in weight. One year and 7 months after transplantation of the ureter we removed a stone from the bladder and there was no evidence of recurrence of the malignancy.

Patient 69835 had a third of the bladder resected for carcinoma and the left ureter was transplanted. He returned for an examination 9 months after the operation and a cystoscopic examination showed the transplanted ureter functioning normally—clear urine spurted from the left meatus and there was no evidence of a recurrence of the carcinoma in the bladder. In a letter 4 years and 1 month after operation he states that his condition is good that he urinates 4 or 5 times a day and about once at night. He has no pain and has not observed blood in his urine.

Patient 80914 came to the clinic with a broad flat carcinoma of the bladder extending to both ureteral

orifices. In August 1913 the growth was excised and the right ureter transplanted. This woman has returned several times for examinations. Two years and 5 months after operation the cystoscope showed that the right ureter was functioning normally but there was a recurring malignant carbuncle. This was removed with the clamp and cauterizer. Nine months later (October 1916) she returned in good condition. Examination with the cystoscope showed that the right meatus was normal. There was no evidence of recurrence of the carcinoma either in the bladder or the urethra.

Patient 86191 had the right quadrant and floor of the bladder resected and the right ureter transplanted for carcinoma. She has returned four times for examination. Her last visit was in November 1916 3 years and 3 months after operation. Her general condition was very good. She had had some frequency and burning on urination for the past six months. Cystoscopic examination showed that the transplanted ureter was functioning normally. However the edges of the ureter appeared to be somewhat reddened and roughened. Otherwise it was normal and no evidence of a carcinoma of the bladder could be found.

Patient 8899 has not returned for examination but wrote to us 3 years after his operation that he felt well. He says that he urinates 3 or 4 times during the day and night, has no pain and has not observed any blood in the urine.

From this review of our cases we would conclude that transplantation of the ureter to another section of the bladder can be performed and the function of the kidney maintained. It seems that this is entirely feasible that it is the procedure of choice in cases of ureteral fistula and that it is much to be preferred to sacrificing the kidney.

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SOME ASPECTS OF RENAL SURGERY<sup>1</sup>

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THE past few years have added little new in the matter of operative technique in renal surgery but much that is new in aids to diagnosis and scientific explanation of the phenomena which occur in diseases of the kidneys. Reviewing my own experience in an effort to determine the important lessons taught me I find that a number stand out in particular prominence. Continuously evident is the frequency with which the urologic surgeon is confronted with questions requiring an intimate knowledge of general surgical diagnostic differentiation, thus emphasizing the necessity that the urologic surgeon have a broad general surgical training that he may intelligently carry on his special work.

In this connection take for example the interrelation of renal affections to abdominal lesions—certain distinct general surgical problems are at once suggested—co-existing lesions of the gall bladder and kidney, the relation between the urinary system and diseases of the female pelvic organs, reflex ileus of renal origin and the jaundice of nephroptosis.

Among my series of patients who have had operations upon the kidney for a variety of conditions, about 10 per cent previous to their renal operation had been operated upon for a distinct and separate lesion and also many patients submitting themselves for operation for a renal condition have had at the same time another pathological condition of sufficient gravity to warrant another operation. The close anatomic relationship of the kidney to the cystic duct, gall bladder, duodenum, pancreas and colon hints at the probability of a mixed symptomatology as the result of a dual affection of the kidney and the upper right zone of the abdomen, and it has not been an unusual occurrence to find a renal calculus in a patient who has at the same time well defined symptoms of gall bladder disease. Whether such association of calculus disease is due to a chronic focal infection with resulting stone formation in the

kidney and of the gall bladder is at present difficult to say.

Rosenow's work on the selective affinity of bacteria and the rather conclusive demonstration that gall stones are probably the result more often of a hematogenous infection than infection by way of the common duct or through the portal system is noteworthy. It may also be presumed that a chronic infection capable of producing gall stones might with equal measure produce renal calculi. In the beginning the symptomatology of one affection might quite obscure that of the other or subjective and objective symptoms be so mingled as to present a complex clinical syndrome. So have we found that in a number of our cases it was only the occasional evidence of epigastric distress that directed attention to the gall bladder. Previous urogenital infection with X-ray testimony seemed to indicate the possibility of the symptoms being entirely due to a lesion of the right kidney.

Other examples of the interrelation of renal affections with abdominal conditions may be found in the close clinical association of typhilitis, mobile caecum, chronic appendicitis and constipation with pyelitis and pyeloureteritis.

Again it is not uncommon for perinephritic abscess to simulate acute appendicitis with abscess. This is of some moment in view of the fact that many cases of perinephritic abscess have had a previous history of abdominal colicky pain, with nausea and vomiting that would suggest an earlier resolving appendicitis. It is probably as common for the appendix to be removed under the supposed diagnosis of acute appendicitis and later an operation for perinephritic abscess to reveal the true condition, as to have an appendectomy performed for symptoms arising from a calculus lodged in the ureter. Recounting the point brought out by Francke of the close interrelationship of the lymphatic anatomy of the cecum and the right kidney and also that biologically, the cecum is the

second great place of normal intestinal stasis where the food naturally remains in the cecum for a variable period where the alkaline contents of the ileum become acid where the fluidity of the intestinal contents is greatest and where of all places in the gastro-intestinal tract the bacterial flora is at the maximum we readily appreciate that here are the etiologic factors in the visceroprotic stasis cases for the initiation of a typhilitis or chronic appendicitis with pericolic infection and resulting lymphatic infection of the right kidney. Thus is easily explained the relationship between right sided pyelitis and conditions of chronic intestinal stasis and particularly such cases occurring in nephropathic women. In like manner sigmoidal diverticulitis may be a causal factor in infections involving the left kidney.

If we invade the territory of the gynecologist we find that time without time retroverted and retroflexed uteri have been suspended or brought into the anterior position to correct a frequency of urination when the primary etiological factor was in the kidney. A knowledge of some underlying minor defects of uterine pathology has resulted in focusing the attention upon what is a secondary pathological process rather than a correct interpretation of the entire diseased picture, or vice versa a suspended uterus has produced an apparent urinary disturbance.

The terminal ureters as they pass along the anterior vaginal wall into the bladder are subject to a number of mechanical injuries either direct or indirect. One cannot help but refer to the splendid work of Clark upon the point of ureteric obstruction and the close association of periureteral inflammation with infections of the ureter and kidney. The resulting injuries to the ureter in obstetrics or compression and infection from inflammatory exudate brings with it a mechanical factor of stasis with distension of the pelvis of the kidney and secondly the more important factor of infection. This is entirely irrespective of whether the infection is transmitted to the kidney by the blood lymphatics or by direct extension of continuity.

The mere passage of bacteria in or through the kidney does not therefore give rise to a

pyelonephritis but some other factor is required in conjunction. The virulence or number of bacteria probably plays a minor role but the most important factor is some previous damage of the kidney substance by a mechanical or chemical agent. (Kidd)

Within the last few years our knowledge in regard to many diseases of the kidney has undergone radical change. It is now questionable if infection of the kidney ever takes place by continuity up the ureter unless the ureter is either stenosed or shows mucosal changes or the ureteral orifice of the bladder is affected. It would seem in the light of recent researches\* by Sweet that the so called ascending infection of the kidney may really take place primarily through the lymphatics.

If we consider further that lumbar demonstrated lymphatics on both sides of the kidney which are connected with those of the diaphragm and on the right side they are also connected with the lymphatics of the liver and the further observation that some lymphatics of the ovary empty directly into the lymphatics of the kidney it is at once apparent that in allied affections of the abdominal viscera we have a sort of continuous route of infection to the kidney with the possibility of the primary focus of disease being in the gall bladder appendix ovaries or abdominal cavities generally.

The relation of right drop kidney to hydro-nephrosis and right sided pyelo-ureteritis and pyelitis the relation of a right sided nephropathy to jaundice have not been sufficiently studied nor is the clinical picture sufficiently clarified for diagnostic purposes. It will readily be seen that a drop kidney will produce the mechanical factor of stasis predisposing to infection. The anatomic relations of the descending and retroperitoneal portion of the duodenum overlying the pedicle and the upper and lower half of the right kidney may account for some atypical cases of jaundice with gastric irritability found in patients with ptotic kidneys.

We have observed a few cases of patients admitted to the hospital with the clinical diagnosis of intestinal obstruction in which the obstructive symptoms were so prominent as to cloud or cloak the real pathology. The

development of meteorism nausea and vomiting usually expulsive in character abdominal rigidity tenderness and pain, with and without temperature and possible leucocytosis strongly simulates intestinal obstruction. A history of the origin of the pain, or repeated attacks and a graphic outline of the distribution of pain has enabled us to determine that the apparent intestinal obstruction was one of reflex renal origin. MacKenzie has described the mechanism of this phenomenon, and Wilms and Treves have drawn attention to the fact in their monographs on intestinal obstruction.

Further study of the chemistry of the blood may reveal that the intestinal symptoms in these cases may not be purely of so called reflex origin but be due to retention of nitrogenous bodies in the blood because of insufficient renal secretion during the attack.

A previous paper entitled Renal Pain I have summarized in the following four main pathological conditions which are apt to be confounded with renal lesions by reason of the symptom of pain. They are (1) coincident disease of the gall bladder and ducts (2) gastroduodenal ulcer syndrome, (3) appendicitis and (4) affections of the large intestine.

The typical pain due to nephrolithiasis is so characteristic as to be readily interpreted. It is therefore of interest to read in Braasch's study of 251 cases of nephrolithiasis that only in 46 per cent was the pain referred to the affected kidney. Distribution of the pain being noted as follows: the region of the gall bladder 12 per cent, the region of the appendix, 12 per cent, in 22 per cent of cases it was referred to both sides and in 16 cases or 6 per cent, the pain was referred to the unaffected side. This transfer of pain to the unaffected opposite side is fortunately rare but it offers some diagnostic difficulty for fortunately less now than in previous days. It merely lays stress upon the importance of complete study of every case from cystoscopic and radiographic viewpoints.

Cibot in his statistical study has called attention to the very pessimistic after results of operation for nephrolithiasis. Under his classification a person who had normal urine

on chemical and microscopical examination and on whom the X-ray was negative was considered cured. In analyzing the series of cases of the Massachusetts General Hospital from the service of various operators he reports of the 66 cases of stone in the kidney 51 per cent were well after operation and 49 per cent were not. We believe that the statistics of individual operators will not show this lamentable percentage of failures for these percentages are at great variance with our own.

Of practical importance is the association of renal stone with renal cancer. By analogy one may presume that continuous chronic irritation of a stone in the kidney is an etiological factor in the production of renal cancer. Statistical data would seem to bear this out. Of the total number of kidneys with cancer operated upon at the Mayo Clinic, 64 plus per cent were associated with stone and 36 plus per cent were without stone. In the true carcinomata that arise from the analogue of the wolffian body 85 per cent of these epithelial tumors were associated with stone and presented an active proliferation of the epithelium of the pelvis extending well out into the pedicle of the kidney. In studying the sections of a carcinomatous kidney containing stones, Coryell was able to observe the gradual changes from normal tissues to inflammatory from inflammatory to hyperplastic, and from hyperplastic to neoplastic, and he opines that it seems probable that chronic irritation brought on by the stones was the direct and etiological factor in the production of cancer.

Bilaterality of renal calculus is a subject replete with interest. After the removal of calculi from a kidney there is an inherent tendency toward reformation which is particularly apt to occur upon the removal of calculi from both kidneys.

The question of choice of operative procedure in bilateral calculus disease is at times a puzzling one. The type of operation to be selected whether it shall be a two stage operation whether the worst kidney shall be attacked first or both sides shall be attacked at the same time is one that requires considerable surgical judgment. The further



question of nephrectomy on one side and nephrotomy on the other side will depend somewhat upon the functional capacity of the other kidney and to what degree it has been functionally incapacitated by the calculus. It has been our practice to operate upon the better kidney first and if the patient is in good condition to do both sides at the one operation.

From the many statistics published and from my own experience I have come to the belief that the watchword in operating for calculus disease of the kidney is *conservative*. There has been too great a tendency to do nephrectomy where nephrotomy would have sufficed.

All of us have had cases which have required secondary operations for recurring calculus in the remaining kidney. In a number of patients I have been called upon to operate on a remaining kidney two or three times for removal of recurrent calculus and yet the patient has made an operative convalescence.

Injuries to the duodenum during the performance of nephrectomy are not uncommon. The mechanism and treatment has been brought out in two very brilliant papers by William J. Mayo. He lays particular emphasis upon the importance of care and detail in performing a nephrectomy. It has been our good fortune never to have injured any of the structures subjacent to the pedicle. Every urologic surgeon nevertheless should be familiar with the technique of repairing such an injury since the life of the patient may depend upon his ability to do so.

In reviewing our cases of essential hematuria we have been unable to arrive at definite conclusions as to the basic etiological factor. Many of the kidneys removed for essential hematuria have shown macroscopically the evidence of a nephritis and upon serial sections have shown the histological evidence of atrophy and fibrosis suggesting a true nephritis. We are not inclined to believe that hematuria can be unilateral as suggested by Senator. The mechanism of bleeding is undoubtedly due to intermittent periods of congestion. It is true that intrinsic causes in the kidney itself such as nephritis, infarct and so on can readily account for it but it is

not unwise to presume that there are not many extrinsic causes that would account for this unilateral phenomenon. Pathologists agree that the lesions found in essential hematuria are confined almost entirely to the glomeruli and represent a glomerulonephritis. These changes are identical with those which we find in kidneys which for long periods of time have been the site of chronic passive congestion. These kidney changes are probably due to a chronic focal infection elsewhere in the body.

Unilateral renal hematuria does not eliminate the possibility of disease of the other kidney. Disease may be present in both kidneys and only one of them bleed. Regardless of etiology we are becoming more and more inclined to be conservative in the treatment; many of our cases have been cured and remain well without further bleeding after a decapsulation. We reserve nephrectomy as a last resort but decapsulation in a number of cases has brought about only a temporary cessation. A recurrence of hematuria in certain cases about 2 years following decapsulation has demanded nephrectomy.

In estimating the resistance and the operative prognosis of a contemplated kidney operation we have found that the phenol sulphone phthalein test and the indigo-carmin test while valuable have not been of as great importance as has been blood chemistry.

The work of Folin and Myers and Fine on blood chemistry has determined certain reactions which permit of more accurate prognosis than functional tests.

From the laboratory examinations we have been able to derive material aid in preventing postoperative complications. Nephritis regardless of the type is accompanied by certain characteristic alterations in the concentration of one or more of the blood elements. Previous to taking up the study of blood chemistry with relation to operative risk we made it a rule to test out functional capacity of the kidneys and have been well pleased with the prognostic value that determinations gave us. There was however a class of patients in whom apparently ordinary functional tests of renal func-

were fallacious. We have found that the estimation of urea, uric acid and creatinin retention have been of much more decided value as a guide to operability. Occasionally a case that has responded in an adequate degree to the phenolsulphonephthalein test and which would seem to indicate the condition would be operatively safe has been operated upon and ended in acute suppression of urine and death. This has been particularly true of the type of uræmic nephritis. Various research workers have shown that in uræmic nephritis, concentration of uric acid and creatinin are far in excess of that observed in other conditions. If one considers that the rate of creatinin which is formed in the body in health and disease is practically a constant quantity and since it is most readily eliminated by the kidney it is found in normal conditions only in small amount in the normal blood, 1 to 2 milligrams per 100 cubic centimeters it follows then that the estimation of blood creatinin if it can readily be carried out is of immense value in the prognosis in this type of case. It would appear that the permeability of the kidney in nephritic states is lowered and becomes evident in the blood first by an increase in the uric acid and secondly by an increase in urea, and lastly by retention of creatinin. Therefore a case that has presented a creatinin retention of 4 to 15 milligrams per 100 cubic centimeters has been a case that has invariably developed marked uræmic symptoms. Examination of uret, uric acid and creatinin has been a matter of great usefulness in indicating the necessity for adequate pre operative treatment and in preventing the development of some of the major urinary complications.

In this brief review of some constantly recurring renal problems and their relation to other surgical conditions I hope to have brought out the importance to the regional surgeon of keeping in close touch with the advances of general surgery and of the laboratory for only in this manner can he justify his claim to special knowledge or peculiar excellence.

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## THE SURGICAL TREATMENT OF BENIGN NEOPLASMS OF THE BLADDER

By EDWIN BEER, M.D., F.A.C.S., New York

From the Medical Service, Hospital for Special Surgery

FOR many years the profession has looked upon all papillary growths of the bladder with greatest suspicion.

The general opinion obtained that though they might be benign anatomically they behaved as do malignant growths. This opinion was founded in great measure on the fact that when such papillomata were operated upon by the usual technique recurrences almost regularly developed. Where there was one original tumor dozens or hundreds might develop after the operative interference which so frequently scattered the disease broadcast over the interior of the viscus to take root in the injured mucosa or in other parts of the wound.

With the introduction of the cystoscopic operative treatment a vast change took place. Nitze undoubtedly deserves the greatest credit for the advance in the therapy of these growths. His series of tumors treated transurethrally with the snare and cautery of his operating cystoscope showed conclusively that if radically removed without traumatism and without producing raw surfaces for tumor implantations there is very little danger of recurrence and that a large number of these papillomata are in no sense malignant. With this knowledge firmly established with these views substituted for the older views it looked as if Nitze's technique would be followed. In a short time however it became apparent that though the will was strong very few could manipulate Nitze's instruments with the results he obtained. Something more simple had to be discovered and for a number of years new types of operating cystoscopes appeared with the greatest regularity. However none of these met the situation. Since 1910 the problem seems to have been met successfully in a different way. Instead of modifying the already complex mechanism of the cystoscope it was decided after careful experimentation to use the ordinary cath-

eterizing instrument and lead through it a destructive cauterizing current. By means of properly insulated electrodes the growths could thus be cauterized with the high frequency current without any difficulty and the ordinary cystoscopist could get Nitze's results without acquiring the expertness demanded by the Nitze technique.

The high frequency cauterization method is simple and effective. Cases that have been adequately treated and subsequently controlled remain free from recurrences. My original cases re-examined five and six years after destruction of the growths showed no sign of tumor in the bladders.

The technique is readily learned and has been so frequently described by me that I shall refrain from going into extensive details at this time. Suffice it to say that three instruments are required: the catheterizing cystoscope, the high frequency current (Oudin) generator and a well insulated copper wire. The tumor is located then the wire electrode is pushed into the papilloma and the previously tested current is allowed to play. Hydrogen gas is seen to bubble out of the growth and its fronds become blanched and necrotic. Multiple points of application are made, lasting about thirty seconds each. This concludes the session and if there is no bleeding as is the rule the patient may be allowed to go home with instructions to return in about six or seven days. During this period urotropin and large draughts of water are taken to keep the bladder clean and to assist in the discharge through the urethra of the necrotic villi. At the second session whatever viable tumor tissue is present is cauterized as at the previous session.

Depending upon the size of the growth the number of sessions will vary. Many growths are destroyed completely in one to two ses-

J. Am. M. Ass. 1912 May 28 Am. Surg. Phila. 1912 Aug. Med.  
Rec'd N. Y. 13 Feb. 8 J. Am. M. Ass. Nov. 14 Am. Surg.  
Phila. 91 June 1 Am. M. Ass. 1914

sions others may require considerably more. I have destroyed very large growths in three to four sessions. The total application of the current necessary to destroy a fair sized growth may be only ten to fifteen minutes.

As I have repeatedly emphasized all cases of papilloma cannot be treated in this simple way. The following types of cases cannot receive the benefits of this simple therapy:

1. Patients that are intolerant. This is a very small and dwindling class. With local anesthesia and judicious use of morphine almost every one can bear the cystoscopic manipulations.

2. Patients that bleed furiously at every introduction of the cystoscope so that no view can be obtained. These cases also are very infrequent.

3. Patients whose tumors are so placed that they cannot be reached e.g. behind large prostatic adenomata, or in diverticula etc. Such cases also are fortunately very infrequent.

4. Patients suffering from papillomatosis of the bladder either primary or following a surgical operation for papilloma which operation has implanted dozens or hundreds of growths all over the bladder wall.

If these four groups of cases cannot be treated by transurethral high frequency cauterization, their only salvation lies in a cutting operation but not in such an operation as is generally in vogue and which scores so very few successes. For the older method we must substitute an entirely new technique which shall safeguard the patient against the danger of recurrences which usually make him a worse sufferer than he was originally.

The important features of this new technique are mainly directed against the danger of breaking off pieces of viable growth which may lead to recurrences. For this purpose the intravesical operation is done entirely with the Paquelin (hooked point) cautery. The bladder is not filled with fluid before opening it; the incision in the bladder is gradually enlarged without any sponging or any rough handling and each tumor as it presents is burned to a crisp every suspicious spot in the bladder is burned and the edges of the opening in the bladder are similarly treated. Finally the whole operative field is

thoroughly soaked in alcohol to destroy any particles of viable growth that might have accidentally broken off during the manipulations. To get an adequate exposure for such an operative technique the patient must be in the Trendelenburg position and the bladder must be drawn out of the abdomen<sup>1</sup> by its urachal end, which technique allows of stripping back the peritoneum with out unduly bruising the bladder and its contained growth or growths. By drawing the viscus out of the abdomen in this way the perivesical space may be well protected from implants with gauze.

The Paquelin may be so used within the bladder for the greater part of an hour without causing any more postoperative discomfort than is usually seen after a suprapubic cystostomy. I have re-examined cases treated in this most thorough manner at periods varying from several months to a year and a half after operation and except for a slight blanching of the mucosa there is no evidence of the extensive use of the cautery.

From my experience I feel convinced that this method of dealing with those cases that can not be treated cystoscopically is a great improvement over the usual more or less careful cutting operation, with its repeated spongings, its grasping of the growth in rude forceps, its circumcision of the pedicle etc. Every step in the technique at present in vogue misses the demands of the situation every step involves breaking off viable growth and invites recurrence.

In conclusion therefore I believe I can honestly state that—

1. All benign papillomata that are suitable cases for cystoscopic high frequency cauterization—and these constitute the great majority—can be definitely cured by this method.

2. Those few cases that cannot be so treated must be operated upon and usually will be cured definitely if the Paquelin cautery technique outlined above is followed.

All malignant cases are excluded. The cases on the treatment described in this paper in a recent publication *Journal American Medical Assoc.* are 96. I have gone into this question

Full technique in paper about to appear in the *Journal American Medical Association*.

## THE SURGICAL TREATMENT OF BENIGN NEOPLASMS OF THE BLADDER<sup>1</sup>

By EDWARD MARTIN M.D. F.A.C.S. PHILADELPHIA

DR BEER has contributed a paper commendable for its brevity remarkable for its clarity and from the standpoint of one appointed to discuss it hopeless for its incontrovertible verity. He has vividly contrasted the hopeless attitude of the surgeon who used to cut papilloma with the justified optimism of the cystoscopist who now burns it. Perhaps there is no one single surgical lesion formerly lethal now brought under complete safe and usually painless control more absolutely than these papillomata of the bladder.

At the suggestion of my associate Dr Moorhead we have made a slight departure from the technique advocated by Beer in that we customarily leave a much longer interval between applications which are at times done as an office procedure. The advisability of this occurred to Moorhead from the circumstance that a patient who was

asked to report back at the end of seven days was unable so to do and at the end of six weeks his very sizable papilloma had almost disappeared. In some of these cases if not all of them the complete effect of the fulguration is not immediately realized nor have we had any occasion in the pure papillomatous cases to regret this longer interval between applications. Bleeding and obstruction by sloughs at times constitute complications the management of which may require skilled attention. Hence these patients should be kept within reach. We have accomplished sacral anesthesia in some cases with entire success but twice it was followed by such long lasting lumbar pain that we now restrict its use to the more irritable cases and repeat it not more than four times.

Patience gentleness and local anesthesia plus morphine usually seem adequate.

Presented at the paper read by Dr. Edwin Beer, Clinical Congress of Surgeons of North America, Philadelphia, October 3, 1906.

DIAGNOSIS OF URETERAL DISEASES WITH THEIR SURGERY<sup>1</sup>

BY BRANSFORD LEWIS M D BSc FACS St Louis

WITH many genito urinary lesions the pathological diagnosis of the existing condition of the organs only does not fulfill requirements, either for diagnostic or therapeutic purposes. Pyonephrosis indicates a distended, pus filled kidney but does not tell of the origin of that condition. Pyelitis or ureteritis or hydro ureter may occupy a similar position leaving much to be desired in the way of diagnosis if we fail to recognize the source and mode of development — pathogenesis.

It is deemed logical and advisable therefore in considering the subject of diagnosis to include a study of the derivation and mode of development of the pathological conditions embraced under the topic assigned to the writer and advert to some of the direct methods of attaining diagnosis later. It will be apparent, however, that the subject assigned is too large to be covered amply and that only certain phases can be touched on in the time at our disposal.

Ureteral diseases are congenital and acquired in origin and primary and secondary in their nature. Those demanding practical surgical consideration are, chiefly the following:

- 1 Infection
- 2 Inflammation
- 3 Obstruction (a) from stricture (b) from kink (c) anomalous vessel (d) pressure from adjacent tissues (tumor scar tissue etc) (e) calculus (f) reduplication (g) malignant growth

**Infection.** It was formerly believed that ureteral infections were uniformly derived from the bladder. Ascending infection was considered as the regular mode of attack; this idea prevailed for a time even for tuberculosis. But tuberculous infection was later recognized as coming through the blood and kidneys and latterly the other more common infections are gradually being ranged in the same category.

While it is obviously possible for infections to travel by mucosa from bladder to ureter

it is probable that the hæmatogenous is by far the more frequent mode of transit and that the usual source is more distant than the bladder in other words that the initial points of invasion are diseased tonsils teeth and nasal sinuses and local points of suppuration at various parts of the body.

From these points the infecting organisms are carried by the blood to the kidneys followed by descending infection of the ureters. Hunner<sup>2</sup> has contributed valuable observations along these lines. In 50 cases of ureteral stricture studied by him only 2 could be ascribed to gonorrhœal infection, and in only 3 could previous cystitis be traced. In one of these a stone had been present to account for the cystitis.

Furniss<sup>3</sup> believes that such infections are of hæmatogenous origin through the kidney with resultant pyelitis ureteritis and secondary cystitis.

It will be noted that these theories have a marked bearing on both questions of diagnosis and treatment. If true they impel the investigator to seek the originating focus of the infection as the cause of ureteritis or of ureteral stricture and point the therapeutic endeavor in an entirely different direction from that which would be based on the view that these conditions are of local rather than of focal origin.

A patient of the writer who had repeated attacks of pyelitis with ureteritis chills and temperature running to 104° was several times cleared up under the influence of hexamethylenamin therapy internally and lavages locally administered through the ureteral catheter. But each time when the urine became perfectly clear and he was permitted to go out of the hospital, there would be a relapse with the same sequence of chills fever and loading of the urine with pus and bacteria (colon) traceable to the kidney pelvis. Pyelitis was plainly demonstrable acute and severe.



tions of the ureter into two classes (a) obstructive or mechanical and (b) inflammatory

In this he seems in accord with the views of Kurofka Korbut<sup>1</sup> who in 1908 declared that in some cases atony of the ureter was a result of an inflammatory process (ureteritis ascendens) and that it could lead to pyelocystia and hydronephrosis

Brasch's belief is that whenever the renal pelvis or ureter become inflamed a change takes place in the wall which causes dilatation

The inflammation superinduces infiltration of the ureteral wall which increases its diameter and caliber and at the same time weakens it undermining its elasticity and resilience, finally leaving it lax and flaccid and dilated ureter without obstruction

The wide difference between the treatments appropriate for the two kinds of ureteral dilatation obstructive and inflammatory will readily be appreciated In the mechanical form the obstruction must be relieved In the inflammatory form the infection and inflammation must be removed and other militating agencies neutralized

While sharing the views of Brasch regarding inflammatory dilatation of the ureter the writer at the same time wishes to suggest the influence of additional factors in promoting the condition In both men and women potential agencies for obstruction exist that are not always obvious to cursory examination Pertaining to similar conditions involving the bladder (atony of the bladder with dilatation) the writer<sup>2</sup> has studied the subject elsewhere with the conclusion that while the cause is not patent in many such cases it nevertheless is present and must be sought for by better and more refined methods of investigation than have been used and is often to be found in unlooked for sources such as silent spinal syphilis or other hidden derangements In women a fertile source is to be found in the form of a tight or spasmodically contracting urethra together with cystitis coli so prevalent and often so formidable reflecting its effects onto the ureters and promoting infection and distention there

In men there are many instances of obstruction at the vesical neck that are more or less obscure or unrecognizable that are not made evident by prostatic enlargement or other outspoken deviation Such conditions have masqueraded under the terms prostatism sans prostate prostratism without enlargement contracture at the vesical neck, etc

Moreover cases that had been abandoned as incurable (atony retention enuresis) were reclaimed to urinary competence and control through the *solution of these questions of the origin and nature of the disability* No case of so called permanent vesical atony was considered or conceded as idiopathic no cases were acknowledged to be without a cause Non recognition of the origin was ascribed to inadequacy of investigation rather than to absence of cause The importance of this phase of diagnosis in urinary disorders is thus made evident

*Ureteral obstruction* While the frequency and importance of the congenital origin of ureteral strictures are somewhat discounted in the remarks previously made this must not be understood as discrediting their existence which is established beyond a doubt Congenital ureteral strictures are very real and very disastrous in many instances as is made evident in a most instructive study of 56 cases by Bottomley<sup>3</sup>

Congenital strictures have been observed to occur in the form of folds of ureteral mucous membrane causing valvular effects as dense infiltrates and narrowings involving more or less length of the ureter even to the extent, sometimes of converting the canal into a solid impermeable cord<sup>4</sup> and also a narrowing of the ureteral orifice which being repeatedly distended stretched and propelled into the vesical cavity finally assumes the form of a globular cyst (ureterovesical cyst) ballooning out into the bladder with each effort at expulsion of urine by the affected ureter It may be plainly seen through a cystoscope This is a condition that pertains to the *mucous membrane* of the orifice rather than to the ureteral canal never

Kurofka Korbut Fol Urol 908 197  
Brasch Low Sit 1 on obscure forms of prostatic obstruction  
and vesical atony Ann Surg Phila 65 March

Certa congenital stricture of the ureter Ann Surg Phila  
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cases ureteral lavages are given occasionally through the ureteral catheter. For this purpose silver argyrol silver nitrate etc. are used.

If the ureteritis is demonstrated to be due to a foreign body (stone) or stricture in the ureter special attention must be given to these.

The therapeutic requirements in both stone and ureteral stricture are being fulfilled in an increasingly large proportion of cases by cystoscopic operative measures. These should therefore be applied before resorting to the more radical measures incident to open operation.

4. Cystoscopic measures for assisting the removal of ureteral stone and the relief of ureteral stricture consist in dilatings of the ureter with both flexible and metal dilators incision of the ureteral meatus when necessary the application of ureteral forceps and high frequency electric current.

5. Cystoscopic measures for the relief of ureteral stricture consist in the use of gradually increasing dilatings by means of (a) ureteral sounds bougies or catheters (b) metal dilators of various sizes and patterns used in a manner to suit each individual case (c) ureteral scissors with which a contracted orifice may readily be enlarged by incision on its dorsal aspect.

6. If the orifice be wholly closed or present the ballooning known as ureterovesical cyst it may be opened up by means of the scissors or the high frequency electric current (d Arsonval bipolar preferred).

7. If destruction of the kidney above the stricture is so great as to render the saving of the kidney ineffectual it should be removed by open operation the ureter being abandoned to become obsolete.

8. Where the ureteral stricture proves unresponsive to dilating measures it may still be saved by plastic measures or by resection and anastomosis in default of which nephrectomy becomes a necessity.

9. A stone presenting at the lower ureteral orifice is removable by cystoscopic measures (dilators scissors or forceps) with practical certainty and should always have the benefit of this procedure instead of the epicystotomy which has been practiced in such cases.

10. In case the stone is located higher up in the ureter the cystoscopic measures for its removal are in consequence the following. The passage of a ureteral catheter with the intent of dislodging the stone from possible attachment to the adjacent ureteral wall the injection of liquid alboline or vaseline through the catheter the passage of successive sizes of dilating bougies the introduction of metal dilators applying their dilating force most strongly at the point of narrowing just below the stone or the use of the movable probang of Cunningham.

These measures may be rendered less disagreeable to the patient by making a preliminary injection of alypin or other sedative solution into the ureter through the ureteral catheter.

11. Following the use of these measures the patient should be cautioned to urinate through a strainer of some kind each time in order to catch the stone if passed voluntarily.

12. The stone being expelled by these means the patient is practically well and capable of returning home without delay. But if the cystoscopic measures repeated two or three times prove unsuccessful the patient is in no worse condition than previously for the open operation that should then be adopted.

13. In the cutting operation for ureteral calculus the extraperitoneal incision is much to be preferred over the transperitoneal. Preliminary ureteral catheterization often facilitates the finding and identification of the ureter and stone.

14. If the stone be located so low in the ureter as to make access difficult it is advisable to use a ureteral forceps or one of the ureteral instruments through the cystoscope with the purpose of pushing the stone back up the ureteral channel until it comes within the operator's reach through the external incision.

15. Complete stopping of the ureter in its exposure is inadvisable because of the interference with nutrition it is liable to entail.

16. It is usually not necessary to stitch the ureteral wound edges after removal of a stone but a drain of some sort from the ureter to skin surface promotes safety.

## INFECTIONS OF THE BLADDER WITH SPECIAL REFERENCE TO LOCALIZED RESISTANT AREAS OF CYSTITIS<sup>1</sup>

BY J. T. GERAGHTY, M.D., F.A.C.S., BALTIMORE

From the James Buchanan Brady Urological Institute of the Johns Hopkins Hospital

OUR present knowledge of diseases of the bladder is due in large part to a single instrument—the cystoscope. Since the introduction of the cystoscope by Nitze, our diagnostic methods have rapidly developed and instruments for the treatment of vesical conditions through the urethra have multiplied rapidly. By means of the many ingenious instruments which have been devised it is possible to cure many vesical conditions which a few years ago would have demanded grave surgical procedures. Diagnostic methods have now become so precise that suprapubic cystotomy simply for the purpose of diagnosis is rarely performed in well conducted urological clinics. The information obtained by the employment of the different procedures available to the urologist is much fuller and more accurate than can usually be obtained from an exploratory suprapubic cystotomy. It is only in rare instances that the urologist is now obliged to fall back upon a cystotomy for the desired information and usually resorts to this procedure with a feeling of chagrin. It is my purpose to review rather briefly our present views regarding infections of the bladder but particularly to call your attention to a type of localized cystitis which has received but scant attention until recently.

**Bacteriology.** Bacteriological studies show quite consistently that organisms of the colon group are the most frequent cause of cystitis both acute and chronic while all of the pyogenic bacteria are capable of producing inflammations of the bladder most of the known forms of bacteria have been isolated by investigators at one time or another. In many cases the infection is a mixed one. Bacteriological studies have further shown that the old idea is no longer tenable that an acid cystitis is usually due to the tubercle bacillus. The urine in the vast majority of cases of simple cystitis is acid. The colon bacillus, the staphylococcus, different varieties of the

streptococcus, the gonococcus, and many other organisms are usually associated with an acid cystitis while organisms belonging to the proteus group are usually associated with an alkaline cystitis and produce the ammoniacalropy mucoid condition of the urine which is so well known. It may be of some interest to note that there is a peculiar specificity displayed by different bacteria for different parts of the urinary tract.

For example the primary focus of tuberculosis in the urinary tract is practically always in the kidney and even then it displays a predilection for certain portions of the kidney the earliest lesions being usually found in the upper pyramidal areas. It is now universally recognized that vesical tuberculosis is practically always secondary to infection in the tract above. In fact, the bladder in many cases of advanced renal disease entirely escapes and in other instances, even when quite severely involved on removal of the tuberculous kidney the bladder lesion tends to disappear spontaneously. The anterior urethra on the other hand, is very resistant to tubercular infection and the disease rarely becomes engrafted on this portion of the tract. The gonococcus is one of the few organisms which is capable of infecting the anterior urethra without predisposing trauma to the mucosa but while the gonococcus has a special predilection for the urethral mucosa of both the anterior and posterior urethra, the bladder with the exception of the trigonal portion, is very rarely involved. In most cases of so called gonorrhoeal cystitis the infection is limited to the trigone. Diffuse gonorrhoeal cystitis is rare, while gonococcus infection of the kidney is even more rare and bacteriologically proved cases of gonorrhoea of the kidney are indeed few. The typhoid bacillus attacks principally the kidney and usually produces a lesion of very mild degree, the result of which is nothing more than a bacilluria, a pyuria being

rather uncommon Typhoid cystitis and typhoid posterior urethritis are most unusual. The colon bacillus, staphylococcus, streptococcus, pyocyanus and other organisms attack the kidney, bladder and posterior urethra apparently with equal facility but rarely the anterior urethra. (Although the urine may be loaded with colon bacilli, staphylococci and other organisms, one rarely sees infection of the mucosa of the anterior urethra from these organisms.) There is one other organism which deserves special mention because of its peculiar action on the urine. I refer to the micrococcus ureæ. This is an organism which implants itself apparently only in the prostatic urethra, does not set up cystitis and apparently is not associated with renal infections. The result of infections with this organism, although it is an organism of slight pathogenicity, may lead to rather uncomfortable symptoms. This organism has the ability to split urea with the liberation of ammonium carbonate. The freeing of ammonium carbonate renders the urine alkaline and results in the marked precipitation of triple and dibasic phosphates, causing these patients to void large quantities of sand. It may be remarked that this infection, while not leading to anything more serious than slight irritation, is nevertheless extremely resistant to treatment—and the prognosis has been bad in my experience as far as its ultimate eradication is concerned. With the possible exception of the tubercle bacillus, there is nothing characteristic in the lesions produced by the various bacteria. It is impossible from the symptoms or the pathology of a vesical lesion to determine the variety of the invading organism. The colon bacillus, for example, may be in one case associated with a most intense, even gangrenous cystitis, but at other times the infection may be of a very mild type, indeed similarly with the staphylococcus, streptococcus and the numerous other organisms which are found. In so far as our therapeutic measures for combating vesical infections are concerned, knowledge of the organism concerned in the infection has proved of comparatively little value.

From time to time special drugs have been

introduced with claims of having a specific action on particular groups of bacteria, but in our experience we have been unable to substantiate the specificity of any of these drugs for any special group of bacteria. The discovery of special drugs with a special action on definite groups or varieties of bacteria still remains a problem for the future.

The management of a case of simple acute cystitis, as far as the diagnosis and treatment is concerned, seldom entails any difficulty. An examination of the urine in conjunction with the history and symptoms is usually sufficiently definite. The treatment is comparatively simple. Our main endeavor in the treatment of these cases should be to place the bladder at rest as much as possible, and this is done in two ways. First, by the liberal employment of sedatives, resorting if necessary to the plentiful use of morphia or preferably pantopon; secondly, the decrease of the bladder activity by decreasing the amount of water ingested. The mistake is so frequently made of forcing water on these patients. If one were to purposely adopt a procedure which would aggravate the condition, he could not select anything more efficacious. The water should be decreased to the absolute needs of the individual, so that the bladder will not be constantly obliged to expel the rapidly accumulating urine. In order to combat the increased acidity of the now concentrated urine, alkalis should be given to the point where the reaction becomes alkaline. Urotropin is useless if the urine is allowed to remain acid; the formaldehyde liberated would but add to the irritation, and if it is rendered alkaline, the urotropin will not be decomposed and consequently no formaldehyde will be present. The use of the drug in acute cystitis cannot be said to have much value. Active treatment such as instrumentation, irrigations and instillations during the acute process are usually more harmful than beneficial. When the symptoms do not subside and the infection persists, it is usually an indication that there is present some complication which is responsible. In such cases a careful investigation must be made to determine this factor. In some it will be found that the cystitis is but

an expression of a renal infection above or there may be some malformation or deformity in the urinary tract which is not allowing complete emptying or evacuation of the vesical contents. In the vast majority of chronic or long resisting infections of the bladder it will be found on investigation that the infection is secondary really to some other focus in the genito urinary tract. Everyone is familiar with the rapidity with which a cystitis will clear up when an unsuspected stricture or a pyelitis is discovered and properly treated. At other times the infection is dependent upon some form of obstruction at the vesical orifice. Occasionally the cystoscope will reveal the presence of a diverticulum which has become infected and owing to the lack of proper muscle in the diverticular sac the contents of the sac are never completely emptied and it serves as a re-infecting focus for the bladder itself. A small series of recurring and persistent urinary infections recently reported by me which had stubbornly resisted all efforts were finally entirely cured by opening and drainage of the seminal vesicles the latent infection in these organs keeping the bladder infected. Occasionally an infected utericle is discovered and elimination of the infection from this source is followed by disappearance of the infection from the urinary tract or again the prostate is at fault. It is now pretty thoroughly understood that before one can begin the intelligent treatment of an infection of the urinary tract that an investigation of the whole tract must be undertaken. In most cases the successful treatment of a case of chronic cystitis will depend upon the ability of the physician to locate the intra vesical or extravescical factor which is responsible for the continuance of the infection and in most instances if this factor can be rectified the cystitis will promptly be cured. The treatment of chronic cystitis has largely become a matter of the treatment of associated conditions or lesions and the prognosis in any given case will depend upon the possibility of removing the contributing cause.

*Localized cystitis.* We are obliged to admit however that in a definite number of cases the failure of the vesical infection to disappear spontaneously is not due to any extravescical

factor. These form a very interesting group of cases. In most of them the disease is not a diffuse cystitis but a localized affair with normal mucous membrane lying between the infected areas the areas may be single or multiple. Sometimes the lesion is a localized area of reddening and hyperæmia at other times there is œdema of the mucous membrane and even the formation of bullæ, and at times superficial ulcerations are observed. When the lesion involves only the mucosa and to a slight extent the submucosa, simple irrigations with silver nitrate or other silver salts particularly if the bladder is overdistended with the irrigation at each treatment, will very promptly lead to disappearance of the infected areas. Where however these localized areas of cystitis involve markedly the submucosa and to a slight extent the muscle of the bladder wall irrigations used in the ordinary way have comparatively slight influence. For the treatment of these resistant areas of cystitis I have been using during the past two years a particularly efficacious method which is as follows. The bladder is filled with salt solution and then an ureter catheterizing cystoscope is passed and an ordinary ureter catheter with out the side eye and with the end cut square is passed into the bladder. The tip of the catheter is then placed against the area to be treated and a 10 to 20 per cent silver nitrate solution injected directly on the area. In this way it is possible to secure a local application of a very strong solution and at the same time not irritate the rest of the bladder.

The excess of silver is immediately neutralized by the salt solution and the effect of a strong application is secured on the area desired. In women by means of the Kelly cystoscope with air distention the application of strong solutions to localized areas is of course readily made and the results obtained by this method have been indeed most gratifying. In the male by the method described above the same therapy is attained. In some instances where the lesion is particularly resistant I have fused a silver nitrate point to the end of a metal tipped ureter catheter and it is possible in this way to paint the desired area with the silver nitrate stick. It

self. By a combination of these methods it has been possible to secure results in the past few years in a large number of cases in which the vesical lesion had resisted all of the ordinary therapeutic measures and the relief afforded the patients was indeed most gratifying. When the lesion involves deeply the bladder muscle nothing short of radical procedures will afford relief.

If on cystoscopic examination one finds a localized area on which the mucous membrane looks whiter than normal with puckered or scarred condition one can feel reasonably certain that no local applications will afford relief. If again there is present an evident mucosa lesion which seems to respond to the local applications but without improvement in the symptoms of the patient one can be reasonably certain that there is deep involvement of the bladder wall. It is our experience that relief of the pain, frequency, tenesmus and strangury which is bitterly complained of by many of these patients can only be obtained by resection of the involved area. It is rather interesting that these areas are frequently single although they may be multiple. They are most frequently found on the lateral walls, the apex of the bladder. Because of their occurrence on the apex they are often missed when indirect cystoscopy alone is employed. When a patient complains of frequent and painful urination whether there is present or not a pyuria before the bladder is pronounced normal it should be investigated by both the direct and indirect forms of cystoscopy.

Neither form of cystoscope alone renders visible every portion of the bladder but by the combined examination all of the bladder

can be readily explored. These cases of what might be termed paracystitis resist all forms of vesical treatment. They form a very interesting group of cases often present themselves with a long standing history of intolerable discomfort and the urinary and cystoscopic findings are frequently out of all proportion to the symptoms of the patient. In some of these cases the urine is macroscopically clear and the most searching examination of the bladder will be necessary to localize the area which is causing the disturbance. Removal of the diseased portion of the bladder will give a most wonderful and satisfactory result and I know of no class of patients more grateful for the relief afforded. Hunner has described these lesions as an obscure form of ulceration and to him should be given the credit of directing our attention to a lesion of the bladder hitherto neglected and undiagnosed. In several cases where the lesions were multiple and on the posterior bladder wall where resection was impossible or inadvisable great relief has been obtained by deep cauterization of the inflamed areas with the actual cautery burning practically through the whole depth of the bladder wall. However where the areas are accessible resection is to be preferred. Simple cystotomy even with long continued drainage fails to afford any relief. In the past these patients have wandered from clinic to clinic and physician to physician without securing relief and have frequently been diagnosed as neurasthenics. The recognition that there is an underlying pathological basis for the symptoms in these patients adds another triumph to the achievements of modern urology.

## THE BLADDER CHANGES DUE TO LESIONS OF THE CENTRAL NERVOUS SYSTEM

### THEIR DESCRIPTION AND TREATMENT

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THE bladder picture due to lesions of the central nervous system depends primarily upon the changes in tonicity of the bladder musculature; this latter term including the fibers of the internal vesical sphincter as well as those of the bladder wall itself. These changes in tonicity of the bladder musculature are of course secondary to lesions in the brain, spinal cord or peripheral nerves. As a result of these nerve lesions and the consequent secondary changes in the bladder musculature, urinary symptoms arise sooner or later according to the location of the lesion in the central nervous system.

The early occurrence of urinary symptoms in these diseases brings the patient often primarily to the urologist for relief. These symptoms if not initial often form a most pronounced feature early in the disease; particularly has this been noted in tabes dorsalis. According to Erb they are initial in 30 per cent of the cases of this disease and Starr states that they are particularly prominent early in the disease in 80 per cent of the cases. They may however occur also in general paresis, lateral and multiple sclerosis, transverse myelitis, syringomyelia and in traumatic lesions and tumors of the cord. These urinary symptoms are incontinence, hesitancy, frequency, dysuria and retention and occur proportionately in the order named. In reviewing the records of Hugh H. Young's cases it is seen that incontinence is the predominant symptom in cases of tabes presenting themselves for treatment, being present in 61 per cent. This may be constant or nocturnal or diurnal. Hesitancy occurred in 21 per cent, retention in 15 per cent and frequency in 13 per cent of the cases. The urinary symptoms may begin with hesitancy or the patient may state that he only has to void twice in twenty-four

hours and that then he does not feel as if he empties his bladder completely.

When the bladder is contracted frequently and dysuria are the predominant symptoms and there may be no residual urine. There may be incontinence in these cases which is usually associated with a cystitis; the incontinence here being due to a complete relaxation of the internal sphincter and the neighboring urethral muscles. When the bladder is dilated hesitancy and retention usually occur and incontinence of the paroxysmal or overflow type comes on later.

As the afferent neurones of the lumbar nerves are the first to undergo degeneration in tabes, the blocking of the sensory impulses from the pelvic viscera and especially the bladder early in the disease is of course the cause of the early appearance of these urinary symptoms in such a large proportion of the cases. The innervation of the bladder is mainly through the hypogastric and sacral nerves. This fact was discovered by Budge (1) and Gianuzzi and Nawrocki (2) working in Claude Bernard's laboratory and has been confirmed by all subsequent workers. Courtade and Guyon (3) state that there are two sets of tracts, the superior composed of communicating branches from the third, fourth, and fifth lumbar nerves connecting with the ganglia of the sympathetic, the inferior mesenteric ganglion and the hypogastrics; the inferior tracts from the second and third sacral nerves (nervus erigens of Eckhard). The bladder also receives branches from the inferior hemorrhoidal and prostatic plexus, continuations of the hypogastric plexus.

The reflex centers for bladder control lie in the inferior mesenteric ganglion and the sacral segments of the cord below the lumbar enlargement, the latter being the more important. Roussy and Rossi (4) have shown that this reflex center is located in the conus

terminalis. The exact location of the cortical center for urination is unknown but probably lies between the arm and the leg centers, the sensory fibers reaching it by way of the posterior columns of the cord.

On account of this complicated and extensive innervation of the bladder and the location of the different reflex centers for the control of urination it will readily be seen how frequently this function may be impaired in disease of the central nervous system. The secondary changes taking place in the bladder wall, both structurally and in regard to its tonicity and the diminution in the tone of the internal vesical sphincter have been demonstrated by cystoscopic and roentgenographic examinations. The roentgenographic examination of the bladder is accomplished by the introduction of some fluid medium which is opaque to the roentgen ray. In making a cystogram the bladder should be comfortably filled with the fluid. Formerly a suspension of bismuth subcarbonate was used for this purpose but this was found to be extremely hard to remove and was quite irritating to the vesical mucosa. Collargol proved too expensive and often left a deposit in the bladder which was hard to remove. It was also distressing everything with which it came in contact. Since the introduction of 10 per cent thorium solution (5) for use in cystography these objections have been entirely overcome.

On cystoscopic examination the bladder wall as a rule shows varying degrees of trabeculation which is evidenced by the marked prominence and hypertrophy of certain muscle bundles, the spaces between them being more or less depressed and leading to the so called cellulæ formation. This change in the bladder musculature was first described by Nitze and considered by him as being quite diagnostic of disease of the central nervous system in the absence of any obstruction to the urinary outflow such as might be caused by prostatic hypertrophy, urethral stricture or valve formation in the urethra. This fact has been elaborated upon by Boehme (6), Fronstein (7) and others. Some authors go so far as to state that the appearance of the trabeculations and their distribution

upon the bladder wall are of diagnostic significance. The etiology of such trabeculation is whether it be a trophic nerve disturbance causing the atrophy of certain muscle bundles rendering others more prominent or whether it be a pure hypertrophy of certain muscle bundles has also been a matter of speculation. The bladder may be very greatly dilated its capacity being markedly increased above normal. It may be contracted and sometimes is quite irritable this latter fact being usually due to cystitis. The mucosa may show varying degrees of inflammation. The trigone as a rule is atrophic, the ureteral ridges and ligamentum interuretericum being much less prominent than normal. The ureteral orifices are often not seen to contract on functioning. They may however be normal in size and appearance or somewhat dilated showing a diminution in the tone of the circular fibers surrounding them. Study of the prostatic orifice show it to be either markedly dilated or to exhibit marked diminution in its tonicity. The cystoscope as a rule can be drawn into the posterior urethra and the intra urethral portion of the lateral lobes of the prostate and the verumontanum readily seen. This maneuver has been used in this clinic for several years in demonstrating the lack of tonicity or dilatation of the internal vesical sphincter. The lack of tonicity of the bladder wall is best shown by the weak outflow of residual urine or any fluid introduced through a catheter for irrigation purposes. There may be no residual urine present or there may be quite large amounts.

The cystograms show by the size of the bladder shadow and its form, the degree of dilatation and the shape of the bladder. The margins of the shadow are often quite irregular and notched due to the presence of trabeculations. By this means the location of the distribution of the trabeculations upon the bladder wall can also be demonstrated. In some of the cases where there was marked diminution in tone of the ureteral orifice some of the fluid has escaped into the ureter and it was found to be dilated another evidence of lack of tonicity of its musculature due to the same cause. When the lack of

tone of the internal sphincter is sufficient to bring about complete relaxation of this muscle the fluid would escape into the prostatic urethra, the cystogram showing the degree of dilatation and the so called funnel shape of the posterior urethra. From a study of the cystograms in the cases which show the funnel shaped posterior urethra it is found that this could only be demonstrated when complete incontinence existed. It will be seen from these plates that there is almost complete closure in the region of the external sphincter.

This funnel shaped posterior urethra has been demonstrated experimentally in cats by Barrington (8) after resection of the posterior sacral roots. In these animals he found that micturition was abolished after division of these roots and that dilatation of the internal sphincter and a funnel shaped posterior urethra could be demonstrated by filling the bladder with collargol and making a roentgenogram. I have carried out similar experiments on dogs and found that after resection of the posterior sacral roots there was marked hesitancy and gradual accumulation of residual urine resulting on about the third day after operation in incontinence. On the first and second days however the animals could urinate at intervals which were rather prolonged and even after incontinence was established the act of urination could still be performed. Figure 1 shows the dilatation of the internal sphincter and funnel shape of the posterior urethra one week after the operation.

Uhle (9) and others have demonstrated that the internal vesical sphincter is of prime importance in bladder closure in man. The incontinence in these patients is therefore due quite often to dilatation of the internal vesical sphincter and urethral muscles and not an incontinence of the overflow or so called paradoxical type.

There is a class of cases in which the cystoscopic and roentgenographic pictures are absolutely typical of disease of the central nervous system but in which no evidence of such disease can be demonstrated clinically.

There was loss of control of the anal sphincter and some motor paralysis in these animals.



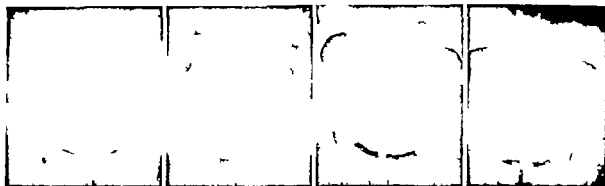
Fig. 1. Cystogram showing a dilatation of the internal sphincter and funnel shaped posterior urethra one week after operation.

or serologically. In one of these cases which came to autopsy lately careful serial sections of the cord from all segments failed to reveal any lesion. The only explanation possible in these cases is that the lesions occur in the ganglia or peripheral nerves and are either quiescent or are not sufficiently extensive to give rise to any clinical or serological manifestations.

The treatment of these cases is most important and while there have been a few which have shown very little if any improvement practically all both clinically and serologically have shown a very marked improvement. Even the temporary amelioration of such distressing symptoms as lightning pains and incontinence is most helpful to these patients but in many instances these symptoms and others have been entirely relieved at least so far as our observations go.

The treatment may be divided into systemic and local. Under systemic treatment comes the intravenous administration of salvarsan, the administration of mercury in various ways and the giving of iodide of potassium. If the patient's blood Wassermann is positive on admission he is given salvarsan intravenously, three tenths to six tenths of a gram each week for four to five doses. Often mercurial inunctions are given at the same time.





1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

and mercury in some form used alone in the salivary is not well tolerated. This treatment is kept up at intervals until the blood Wassermann becomes negative and has remained so for a year after all treatment has been discontinued. Under this head will also come the intradural treatment for which either mercurialized or salivary serum may be used. In this clinic we have used the former according to the method of Dr. C. M. Byrnes (10) of the Neurological Department. If the spinal fluid on admission shows a positive Wassermann, a cell count above normal, a positive globulin test (both Ross Jones and Hanly) and the gold chloride test shows either a parietic or luetic curve from 1/50 to 1/5 of a grain of mercurialized serum is given intraspinaly once a week for four to five treatments. An interval of several months is then allowed to elapse at the end of which time another spinal fluid and blood Wassermann examination should be made and if sufficient indications be present another series of intravenous and intradural treatments instituted. Under such treatment the first and most marked improvement consists in the gradual lessening and disappearance of the lightning pains; improvement in incontinence which in some instances has been temporary and in other apparently permanent improvement in gait

the ataxia and muscular incoordination being apparently much less and also an improvement in the patient's general condition from a nutritional standpoint has been noted in many cases. For example a patient who complained on admission of slight nocturnal incontinence, lightning pains and ataxia and whose blood Wassermann was negative but whose spinal fluid showed a positive Wassermann, a cell count of 85 per cubic millimeter, a positive globulin test and a gold chloride showing a parietic curve was given five intraspinal treatments of mercurialized serum in thirty-eight days four of which were 1/50 and one 1/25 of a grain. During this period of treatment the residual urine was decreased from 250 cubic centimeters to nothing and his gut became more steady. He voided once at night and had no nocturnal incontinence. During his stay in the hospital he was also given two dilations with the Kollmann dilator up to 30 F. On discharge from the hospital at the end of thirty-eight days the spinal fluid examination was as follows: cell count 40 per cubic millimeter, globulin plus Wassermann negative and the gold chloride still showed a parietic curve. Examination of this patient five months later showed a negative blood and spinal fluid Wassermann, a cell count of 8 per cubic millimeter, globu-



Fig. 6

Fig. 6 Case 3. Cystogram showing the bladder dilated. Internal sphincter closed.

Fig. 7

Fig. 7 Case 3. Cystogram showing a bladder shadow smaller than normal with irregularities at superior margin due to trabeculation. Dilated internal sphincter. Funnel shaped posterior urethra.

Fig. 8

Fig. 8 Case 4. Cystogram showing the bladder shadow spherical in outline with margins slightly irregular due to trabeculation. Dilated internal sphincter.

lin plus (Ross Jones Pandey?) gold chloride negative. The pains in the legs had disappeared entirely and occasionally he was having slight nocturnal incontinence. The ataxia had improved very markedly, as had his sexual powers. The patient is to return in six months for further observation.

Under local treatment is considered the relief of incontinence, the reduction of residual urine with the consequent improvement in kidney function which is often impaired as a result of back pressure, the same phenomenon as observed in prostatic hypertrophy or stricture of the urethra. The incontinence seems to be markedly benefited if not entirely relieved by urethral dilatation. In one case the mere passage of a cystoscope caused permanent relief of incontinence. Dilatation of the urethra with filiform and followers sounds and the Kollmann dilator have been quite effective in many cases. Such regular dilatations in connection with intraspinal and intravenous therapy were carried out in Case 1. The dilatation should be done once or twice a week. If the residual urine be large in amount and uninfected

there should be catheterizations at regular intervals or if the residual urine be very large and the phenolsulphonephthalein output be very low the patient should be put to bed and continuous catheter drainage instituted. Great care should be taken to avoid infection in these cases for on account of the lowered resistance of the patient once introduced it often spreads very rapidly and causes in turn cystitis, ureteritis, pyelitis and pyelonephritis unless measures be instituted to check it. If infection be present the patient should be given large doses of urotropin, boric bladder irrigations twice a day while the retention catheter is in place and frequent bladder instillations of 10 per cent argyrol. The pyelitis is best treated by lavage of the renal pelvis with silver nitrate solution.

Under this heading may also be considered the operative procedures undertaken when there is a coexistent prostatic hypertrophy. Dr Young has performed perineal prostatectomy on several of these patients with complete relief of the urinary symptoms where there has been a median prostatic bar. He has excised this by means of the punch operation with a similar result (11). It is in





Fig. 9 (at left) Case 5. Cystogram showing oval shaped bladder. Margins irregular due to trabeculation. Dilated internal sphincter. Tunnel shaped posterior urethra.  
Fig. 10 (at right) Case 6. Cystogram showing a pyriform shaped bladder shadow with marked irregularity of the superior and lateral margins due to trabeculation. Dilated internal sphincter. Tunnel shaped posterior urethra.

was 82 per cubic millimeter. The gold chloride was positive in the pyretic zone. The rectal examination showed the anal sphincter to be of poor tone and the prostate not enlarged.

On cystoscopic examination no residual urine was found, the bladder capacity being 300 cubic centimeters. The bladder wall was injected and trabeculated toward the vertex and its tonicity was poor. The trigone was atrophic. The ureteral orifices were normal in appearance. No intravesical hypertrophy of the prostate was made out. The cystoscope could be drawn into the posterior urethra and the verumontanum seen. With the finger in the rectum and the cystoscope in the urethra there was no thickening of the median portion of the prostate nor trigone. The cystogram of this case (Fig. 7) shows a bladder shadow smaller than normal with irregularities at the superior margin due to trabeculation. The internal sphincter is widely dilated the bismuth suspension having escaped into the prostatic urethra giving a funnel shaped shadow. The right ureteral orifice is dilated and the bismuth suspension has escaped into the right ureter which is also seen to be dilated.

**CASE 4.** *Tuberculosis dorsalis.* Wassermann negative. Incontinence. No residual urine. Dilatation of the internal sphincter.

**E. E. W.** Age 3. Ataxia had been present for 1 1/2 years. For the last six weeks there has been frequency of urination and incontinence. There had been loss of sexual power for one year. The blood Wassermann was negative. Rectal examination showed the anal sphincter to be markedly atonic. The prostate and seminal vesicles were normal. On cystoscopic examination no residual urine was found.

The bladder capacity was 300 cubic centimeters. There was no intravesical enlargement of the prostate. The bladder wall was distinctly trabeculated. The trigone was hypertrophied. The ureteral orifices were easily seen and apparently functioning well, the urine from either side being clear. The cystoscope could be drawn to the posterior urethra and the verumontanum readily seen. The cystogram (Fig. 8) shows the bladder shadow to be spherical in outline, its margins being slightly irregular due to the presence of trabeculation. The internal sphincter is dilated as is the external sphincter the thorium solution having escaped into the posterior and also into the bulbous urethra. In this instance constriction had to be applied to the urethra after the catheter was removed in order to retain the thorium solution. The posterior urethra shows a tendency to become funnel shaped.

**CASE 5.** *Tuberculosis dorsalis.* Incontinence. Residual urine 800 cubic centimeters. Dilatation of internal sphincter.

**R. H. H.** The present illness began five years ago with frequency and urgency of urination. The patient had had incontinence for three years. There had been loss of sexual powers for the past twelve years. On rectal examination the anal sphincter was found to be of good tone. The prostate was moderately hypertrophied. On cystoscopic examination the residual urine was found to be 800 cubic centimeters and only 400 cubic centimeters could be reintroduced into the bladder without causing the patient much discomfort. The prostate was found to be enlarged intravesically, the enlargement being mainly in the left lateral lobe and to some extent in the median portion. The bladder wall was

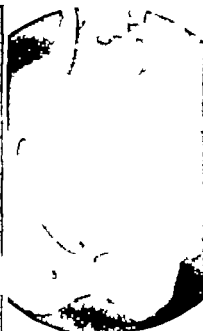
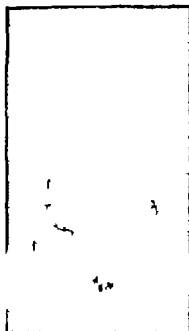


Fig. 1. Cystogram showing the bladder and ureters. The bladder is dilated and shows trabeculation. The ureters are visible as thin lines extending from the bladder.

markedly trabeculated on the posterior and lateral walls. The trigone was hypertrophic and somewhat hypertrophied. The ureteral orifices could not be made out definitely on account of the adenoma of the trigone. The vesicoscope could be drawn to the posterior urethra but on account of cloudiness the ureterostomium could not be seen. The cystogram (Fig. 1) showed the bladder had to be of a shape the long diameter being directed from above downward. Throughout the whole extent the margin is irregular due to trabeculation. There is dilatation of the internal sphincter of the thorium solution having escaped into the posterior urethra giving a funnel-shaped shadow.

CASE 6. T. H. G. dorsalis Wassermann (blood and spinal fluid) negative. Incontinence. Residual urine 450 cubic centimeters. Dilatation of the internal sphincter. Lightning pains relieved by systemic treatment.

J. H. G. age 6. The onset was fifteen years ago with hesitancy and a feeling of inability to empty his bladder completely at each urination. For the past twelve years incontinence had been constant. General symptoms began about this time. The patient has lost his sexual powers completely for the last four years. There was a history of lues thirty-two years ago. Blood Wassermann was negative. Spinal fluid Wassermann also negative.

Fig. 2. Cystogram showing the bladder and ureters. The bladder is dilated and shows trabeculation. The ureters are visible as thin lines extending from the bladder.

cell count four globulin negative and gold chloride negative. Rectal examination showed the anal sphincter to be of poor tone, prostate and seminal vesicles normal. On cystoscopic examination 450 cubic centimeters of residual urine was found. Bladder capacity 450 cubic centimeters. There was no trabeculation or hypertrophy of the prostate. On account of the marked dilatation of the internal sphincter some enlargement of the right lateral lobe intraurethrally could be made out and the size of the diverticulum as seen on the left lateral wall. The cystoscope could be drawn into the posterior urethra. The ureterostomium could be seen. The bladder wall was markedly trabeculated laterally and posteriorly. The trigone was atrophic. The cystogram (Fig. 2) showed a bladder shadow pyriform in shape with marked irregularity of the anterior and lateral margin due to trabeculation. There was a diverticulum present on the lower left lateral wall. The internal sphincter was dilated some of the thorium solution having escaped into the posterior urethra. This patient had a marked suppurative pyelonephritis and cystitis and after each urethral dilatation had such a marked reaction that they had to be discontinued. Although from the serological examination it would seem that the disease process was quiescent he was given intrasacral therapy with the hope of relieving the lightning pains. This was accomplished but no improvement as regards the incontinence was noted.

**CASE 7 Cerebrospinal lues Wassermann negative** Residual urine 135 cubic centimeters Dilatation of the internal sphincter and left ureteral orifice

W C age 55 The onset of the present illness was fifteen years ago with hesitancy and frequency of urination There had been burning on urination for the last five years For the last six months on account of the residual urine the patient had been catheterized daily There was a history of syphilis thirty one years ago after which the patient had thorough systemic treatment The blood Wassermann was negative On rectal examination the anal sphincter was found to be of fair tone a slight grade of proctitis and seminal vesiculitis was found to be present On cystoscopic examination the residual urine was found to be 135 cubic centimeters and the bladder capacity 225 cubic centimeters There was no intravesical enlargement of the prostate, the bladder wall was markedly trabeculated the trabeculation being general the trigone was somewhat hypertrophied With the finger in the rectum and the cystoscope in the urethra, there was less tissue felt than normally in the region of the median portion of the prostate

The cystogram (Fig. 11) shows a bladder shadow which is pyriform in shape There are irregularities surrounding the whole margin due to trabeculation particularly marked on the superior and lateral margins There is a slight degree of dilatation of the internal sphincter some of the thorn solution having escaped into the posterior urethra which shows a tendency to become funnel shaped The left ureteral orifice is evidently dilated the thorn solution having escaped into the ureter which is also somewhat dilated

**CASE 8 Paraplegia Wassermann (blood and spinal fluid) negative Incontinence** Residual urine 175 cubic centimeters Dilatation of internal sphincter and ureteral orifices

E G age 42 Paraplegia due to a fracture of the lumbar spine After the injury ten years ago the patient had complete paraplegia with incontinence of urine and feces which conditions persisted up to the present time The blood and spinal fluid Wassermanns were negative Rectal examination showed that there was occasional spasmodic contraction of the anal sphincter The prostate and seminal vesicles were normal

On cystoscopic examination 175 cubic centimeters residual urine was found Study of the prostatic orifices showed it to be slightly irregular and edematous The bladder wall was trabeculated anteriorly and on its right lateral and posterior surfaces The trigone was thickened the ligamentum interuretericum was hypertrophied and slightly elevated At either corner of the trigone there was a shallow pouch or beginning diverticulum at the bottom of which on each side was situated the ureteral orifice When the ureter functionated the orifice was seen to contract and rise from this shallow diverticulum, immediately receding upon

the cessation of the contraction The cystoscope could be drawn into the posterior urethra and the verumontanum could be seen

The cysto ureterogram (Fig. 12) shows the bladder shadow to be somewhat pyriform in outline The thorn solution has escaped into the ureters due to the dilatation of the ureteral orifices The margin of the bladder shadow is markedly irregular due to trabeculation The internal sphincter is dilated some of the thorn solution having escaped into the prostatic urethra giving a funnel shaped shadow The shadows of the ureters show them to be markedly dilated and there is also a linking of the right ureter

**CASE 9 General paresis Wassermann (blood and spinal fluid) positive Hesitancy and frequency** Residual urine 1550 cubic centimeters Diminution in tone but not complete relaxation of internal sphincter

C L age 33 This patient had had general symptoms for two years He had had hesitancy and frequency of urination for the past six weeks The blood and spinal fluid Wassermanns were positive The globulin tests were positive The spinal fluid cell count was 26 per cubic millimeter The rectal examination showed the anal sphincter to be of good tone The prostate was not enlarged

On cystoscopic examination 1550 cubic centimeters residual urine was found The bladder wall showed slight trabeculation at the vertex and in the region of the ureteral orifices The trigone was atrophic, the ureteral ridges were less prominent than usual The ureteral orifices were sunken and did not contract on functioning The prostate was not intravesically hypertrophied The tonicity of the internal sphincter was impaired The cystoscope could be drawn into the posterior urethra and the verumontanum plainly seen No thickening of the median portion of the prostate or trigone was made out

The cystogram (Fig. 13) shows an enormously dilated bladder which is ovoid in shape There is slight irregularity of the margin of the shadow superiorly and on the left lateral wall due to trabeculation The internal sphincter is closed no bismuth suspension having escaped into the posterior urethra

This case shows that an enormous dilatation of the bladder can take place without incontinence and relaxation of the internal sphincter

#### SUMMARY

The chief changes in the bladder due to lesions of the central nervous system consist in diminution in the tone of its musculature and that of the internal vesical sphincter As a result of such loss of tonicity there is often a gradual accumulation of residual urine and in some instances a dilatation of the bladder Incontinence occurs in a large majority of

the cases. Where this exists there is a dilatation of the internal vesical sphincter and a funnel shaped posterior urethra which is readily demonstrated cystoscopically and radiographically. The incontinence may be a true paradoxical incontinence due to the gradual accumulation of residual urine and overdistention of the bladder or it may be due directly to a relaxation of the internal vesical sphincter and the neighboring urethral muscles. In this latter type there is usually no residual urine present. The trabeculation of the bladder wall although generally present seems to be rather inconstant in its distribution. The trigone is usually found to be atrophic. The cystoscope as a rule can be drawn into the posterior urethra and the verum nitium and intra urethral portions of the lateral lobes of the prostate easily seen.

The most effective form of treatment in these cases consists of intravenous and intraspinal therapy combined with dilatation of the urethra. This has been carried out in 21 cases when the lesion of the central nervous system was due to syphilis. Incontinence occurred in twelve of the cases, in 5 there was entire relief, in 6 marked improvement and 1 remained the same. There was difficulty of urination in 7 cases which cleared up entirely in 5 and was markedly improved in 1.

Frequency of urination occurred in 5 cases being entirely relieved in 3 and made much better in 1. In 10 of the cases lightning pains formed the predominant symptom under treatment this disappeared entirely in 7, 2 were markedly benefited and 1 showed no improvement. Of the 6 cases having marked urinary 3 showed some improvement and 3 remained the same.

Of the 15 cases 10 gave a history of previous syphilitic infection, 7 had a positive blood Wassermann on admission and in 14 the blood Wassermann was negative. The spinal fluid Wassermann was positive in 20 of the cases on admission and in 9 is negative at the present time. There has been a decrease in cell count in 8 cases. In 9 cases the globulin has remained positive in 4 it has become negative in 3 it is doubtful. (Both Ross Jones and Pandey tests were used.) The gold chloride changed from a luetic curve to a

negative one in 5 cases from a paretic curve to a negative one in 1 case remained the same in 8 cases changed from a luetic to a paretic curve in one instance and from a paretic to a luetic in another and was not done in 4 cases.

Nineteen of the cases had intraspinal treatment in 7 of these it was combined with intravenous therapy and in 8 with dilatations of the urethra. In 1 case intravenous treatment alone was given.

From these observations it is seen that the majority of these patients have been benefited very markedly if not entirely relieved by this form of treatment the improvement in many instances being not only shown clinically but also serologically.

I wish to thank Dr. Hugh H. Young, Clinical Professor of Urology for having suggested this study and Dr. C. A. Waters of the Department of Roentgenology for his valuable assistance in the radiographic work.

I desire also to express my appreciation to Dr. H. M. Thomas, Clinical Professor of Neurology, Dr. Adolph Meyer, Professor of Psychiatry and Dr. T. C. Jewett, Professor of Medicine for their kindnesses in placing additional clinical material for this study at my disposal.

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## EARLY DIAGNOSIS OF RENAL TUMOR

WITH THE REPORT OF 5 CASES AND THE DEMONSTRATION OF SEVERAL PNEUMOGRAMS ILLUSTRATIVE OF THE DIFFICULTY<sup>1</sup>

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THE effort in every cancer problem is to make a diagnosis early enough to offer an opportunity of clean complete removal. The application of this principle in the treatment of breast and uterine cancer has resulted in a creditable increase of cures. These diseases gave early symptomatic manifestations and as a result of wide educational propaganda women realize the danger of delay and come for diagnosis and treatment at the onset of the symptoms. The fact that the first metastases occur along the lymphatics still gives those who fail to come in the precancerous stage the chance of cure by radical removal of the tumor and thus primary lymph zone. In malignant disease of the kidney conditions are different. Clinical manifestations are very erratic. No precancerous or early symptoms are known. Death may result without any clinical evidence of renal involvement. Seventy two per cent of the cases of A. O. J. Kelley's (1) pathologic study (1895) came to autopsy undiagnosed and yet all but 2 of these had advanced lung or liver metastasis. Kroenlein (2) ten years ago confessed his inability because of insufficient signs or symptoms to make an early diagnosis in even 1 of his 20 cases. Another contrast is in the mode of metastasis. The lymphatic route is one of the least frequented. Long before the primary renal lymph zones along the aorta have become involved the renal vein may have carried tumor cells to the lungs, liver, bones or any part of the body. Implantations into neighboring organs in the peritoneal cavity or along the urinary tract (Barney, 3; Swan, 4; Garceau, 5) may have occurred. Any such mode of extension nullifies the value of wide lymphatic dissections as enthusiastically advocated ten years

ago by Gregoire (6). Surgeons cannot cure renal tumor in the face of generalized metastases and so long as surgery remains the only cure improvement in the late surgical results will depend upon an accurate diagnosis before metastasis more than upon any radical operative technique after. A glance at the mortality reports (Table I) will emphasize the difficulty in making an early diagnosis. The average of four observers gives a five year cure of only 8.2 per cent a mortality of over 90 per cent. Moreover a five year time limit for cure does not give the true mortality. Many cases have died of metastasis more than six years after operation. Kroenlein reports a case which lived twelve years after operation before death from metastasis. A comparison with the results in the treatment of cancer in which early diagnosis and radical surgery are possible is striking. Judd reports a five year cure in 39.8 per cent for cancer of the breast and Wertheim 42.4 per cent for cancer of the uterus.

The various histological forms of malignant tumors of the kidney parenchyma do not as a rule permit of clinical differentiation. Furthermore tumors of the kidney pelvis, perirenal tumors and cystic formations of the kidney may give similar clinical and urological pictures. There are a few facts of differentiation between the four groups: perenchymal, perirenal, pelvic and cystic. The present consideration of early diagnosis will be confined to malignant tumors of the kidney parenchyma in the adult. Of Kuster's (7) 307 cases 261 or 70 per cent were parenchymal tumors, hypernephroma, about 70 per cent sarcoma and carcinoma about 20 per cent and the remainder adenoma and

It is not intended to condemn the radical operations (Gregoire) if every kidney tumor should be removed (possible as in renal capsula (Verro, Zuckerkandl)) and all renal glands should be cleanly removed.

Five: papilloma, papillary epithelioma, carcinoma, sarcoma. Perirenal: (tumors of kidney capsules) in situ, sarcoma, lipoma, fibroma, myxoma. Cyst: dermoid, retroperitoneal, serous, polycystic.

Kroenlein (2) analysis of 211 cases of metastasis shows the lymphatic glands involved only 58 times or in 28 per cent. Lungs 9, liver 77, second kidney 41, bones 3, placenta, abdominal wall 0, peritoneal 14, brain, bladder 6, etc.

Garceau (5) an analysis of 76 cases of hypernephroma found bone metastases most frequently with lung next and regional glands third.

Read in the Symposium on Tumors of the Kidney at the Meeting of the California State Medical Society April 9, 1916



TABLE I

Author	Year	No. of Cases	Hypertension	Hematuria			Tumor			Pathology	Life expectancy	Results of Nephrectomy		
				Is it	Only	Ob served	Is it	Only	Ob served			Life expectancy	Only	Ob served
Average				27	6	6	27	6	6			27	6	6
Wiley (1)	1912	1												
Wiley (2)	1912	1												
Wiley (3)	1912	1												
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Wiley (100)	1912	1												

41 living, 13 dead, 1 not stated, 1 McBurney, 1 Dukes

embryoma. About 6 per cent of all renal tumors are benign (Keen).

The diagnostic problem contains three parts for consideration: the clinical symptoms and signs, the findings of a urological examination and the correlation of the clinical and the urological findings. The signs and symptoms remain as formerly the principal factor in the diagnosis but are rarely pathognomonic. The urological findings unless verified by clinical facts cannot in themselves make a positive diagnosis. Their greatest value is in differential diagnosis and in the identification of clinical facts. The correlation of all clinical and urological evidence may make a positive diagnosis and will at least give the foundation of safety otherwise impossible.

*Clinical evidence.* About one third of the cases reported in the literature (see Table I) have had when they came to operation all three of the so called cardinal symptoms of renal tumor: hematuria, pain and tumor. It would be interesting to know the late results of nephrectomy in this group with complete symptoms as compared to that in which only one of the triad was present. Diagnosis based upon complete symptoms cannot be considered an early diagnosis. An early diagnosis implies one which precedes metastasis, of which the duration or completeness of symptoms is a very unreliable index.<sup>1</sup> Cases are on record with symptoms ten to fifteen years before that have remained well after operation. Cases with symptoms of a few months' duration at the time of operation have died of metastasis, and other cases have been known to succumb with kidney carcinoma without having had any of the classical symptoms. Case 3 died seven months after the first and only attack of hematuria. In general the probability of the onset of metastasis increases with the duration of symptoms. Identification of symptoms in the very beginning will constitute therefore in the light of our present knowledge an early diagnosis.

An analysis of the records of several reliable observers is given in Table I. Hematuria

<sup>1</sup> Carcinoma and sarcoma metastasize more rapidly than hypernephroma.

varies as an initial symptom from 70 per cent in Israel's (8) 66 cases to 21.4 per cent in the 32 cases of Albrecht (9) and gives an average incidence, as the onset symptom, of 42 per cent or in 301 of the total of 709 cases of eight different surgeons. Pain is the initial symptom in 204 of 643 cases or 32 per cent and tumor is the initial symptom in 113 of 611 cases or 18.5 per cent. It is the exception for a case to come to operation before it has developed more than one of these symptoms. Hematuria remained the only symptom in 14 of 209 cases or 6.6 per cent, pain, in 24 of 157 or 14 per cent and tumor in 17 of 209 or 8.1 per cent. These facts indicate the lost opportunity in making an early diagnosis. At the time of operation presumably of diagnosis also less than 10 per cent had one symptom only while in 42 per cent hematuria had been the initial symptom, in 32 per cent pain and in 18.5 per cent tumor. More than one symptom is uncommon at the onset. Pain and tumor were noted first in only six of Barney's 74 cases, pain and hematuria in six also and hematuria and tumor in only one case. According to Hendon (10) 90 per cent of hypernephroma cases show hematuria before the tumor can be palpated and he cites a case with ureteral coagula appearing some ten years before the tumor. Denaclara (11) notes the significant observation that in only one of 146 cases of hematuria in renal neoplasm (409 case reports analyzed) did the attack last as long as 14 days, a fact of some clinical importance in differentiating other hematurias.

The accurate identification of initial symptoms is difficult. The two most frequent of these hematuria and pain are common occurrences from other causes. Furthermore, a surprisingly large number of cases have their first intimation of trouble through gradually developing weakness and loss of weight, clearly an initial symptom which promises little for early diagnosis. Nine per cent of Willen's (12) 20 per cent of Squier's (13) and 15 per cent of Kroenlein's (2) case had cachexia as the onset symptom. Metastasis, vomiting (as in Case 1), varicocele or a caput medusæ, swelling of the legs or even uræmia (Weber 14) may be the first distur-

bance. Nevertheless an early identification of hematuria of abdominal and lumbar pain, and of abdominal tumor, which are more likely to be early, remains the logical solution of the problem of early diagnosis. An urological examination is here invaluable.

*Urological evidence.* The catheterization of ureters and a report of the findings of the two separate urines does not constitute an urological examination. Such an abbreviated examination a request for which almost every urologist has experienced will almost invariably fail in furnishing the facts of differentiation which are its chief value. Three precystoscopic procedures are of vital importance to a satisfactory study: complete urinary findings, X-ray exploration of kidneys, ureters and the bladder and an estimation of total renal function. The urine for examination should be bladder urine free of contamination and may be obtained by having the patient void in three sterile glasses, the third glass being used or better particularly in women or where cultures are to be made, by catheterization of the bladder. The determination of macroscopic or microscopic blood before any form of urethral instrumentation bears a considerable value. Albumin, pus, casts or blood were found in 61 of Barney's 74 and in 39 of Pleschner's (15) 41 cases. Ten only of the 74 had normal urines. The amount and character of pus and the absence or presence and their type of organisms has precystoscopic significance. Sterile pus signifies tuberculosis in the majority of cases but may accompany stone, gonorrhœa or tumor necrosis.

The X-ray exploration is seldom of much value in identification of tumor unless associated with pyelography. But plain skiagrams may show shadows in the kidney region or line of the ureter in order to identify which, particular procedures will be used in the cystoscopic examination which otherwise might be neglected. The finding of stone in the kidney does not eliminate the possibility of tumor. Nogura (16) reports a hypernephroma associated with a stone weighing 400 grams. Coryell (17) has emphasized stone as an etiologic factor, finding 9 of 14 consecutive cancer cases at the Mayo Clinic

associated with stone illustrative of changes through inflammatory irritation to hyperplastic and hyperplastic to neoplastic. In Case 3 on the contrary stones were shown by X ray on the opposite side and a very much injured kidney containing multiple stones with a unipolar sarcoma of the other kidney found after death from uræmia. The X ray may show differences in size of kidney shadow and has a considerable value in locating bone and lung metastasis.

The estimation of total renal function has a twofold value. It may indicate a bilateral lesion and will control possible error due to inhibition of function at the time of the separate functional study of the two kidneys. For this estimation phenolsulph nephthalein is incomparable. It is the only test which gives absolute values. In certain cases one of the retention tests such as blood urea or blood nitrogen will add additional information of total renal capacity. The total functional estimation performed precystoscopically acts as a control of inhibition which not infrequently occurs upon ureteral catheterization by indicating what the half hour output of the two kidneys should be. Any figure below this in conjunction with a knowledge of the continued patency of the catheters and relative flow on each side particularly if there has been no leakage about either catheter will influence the interpretation of the findings.

The cystoscopic examination should be undertaken with the object of obtaining complete information. All possible causes for the signs or symptoms must be tested. The conduct of the examination will depend on the indication of precystoscopic findings and of facts picked up as the examination proceeds. A complete kidney examination preceded as just stated comprises the following steps:

1. The determination of the amount of bladder residual and bladder capacity.
2. The inspection of bladder of bladder neck and of both ureteral orifices.
3. The collection of separate urines with out trauma for the determination of the presence of renal or ureteral blood.
4. The passage of wax tipped catheters.

5. The ureteral catheterization including

A. Collection of separate specimens for chemical microscopic and bacteriologic examination and for animal inoculation.

B. Measurement of the capacity of the two kidney pelves and the identification in character and location of the renal pain produced upon overdistention of the renal pelvis with the clinical pain which the patient has experienced.

C. Separate functional study with phenol sulphonephthalein given intravenously and controlled for inhibition of function and for catheter leakage.

6. Ureteropelviography.

It will not be possible or necessary to analyze each of these steps. The nature of the information to be gained by each one is evident. It is possible to do each in the order outlined through the one cystoscope at the one and the same examination. If the rubber sheath and wax tipped catheters are previously prepared very little more time is added to the ordinary ureteral catheterization and the need of a second examination which some patients refuse may be avoided.

The third step so far as known is new. No technique for use in the male has ever been described for obtaining urine from the separate ureters without trauma and the resultant presence of red blood cells. Kelley has noted the value of this procedure in connection with the use in the female of his open ur endoscope the end of which may be placed over the ureteral orifice and the urine collected through it uncontaminated with the bladder contents and without trauma to the ureter or its orifice. In those cases where there is slight bleeding from one kidney the source of the blood cannot always be determined by inspection of the ureteral orifice and this determination is frequently difficult even when bleeding is profuse. The insertion of a catheter into the ureter almost invariably sets up bleeding which may be considerable. The presence of blood therefore after ureteral catheterization has no diagnostic significance. To eliminate this difficulty and error the following procedure has been used several times recently with success. A rubber sheath longer but otherwise similar to that used for

the passage of a wax tipped catheter (18), is used through the operating telescope (Brown Burger). Inside of the rubber sheath a ureteral catheter, which tightly fills it, is inserted to within a few millimeters of the end, and this catheter is in turn plugged with a wire stylet. After passing the cystoscope and observing the ureteral orifice if there is doubt of renal hemorrhage and red blood cells have been previously found in the bladder urine the rubber sheath, plugged with the catheter and stylet, may be inserted and its inner end accurately placed over the ureteral orifice (Fig 1). An assistant then removes the stylet. That the sheath is properly placed over the ureter must be continuously observed through the instrument and will also be shown by the intermittent flow from it. After collecting one or more specimens on a slide for immediate examination or in a test tube the sheath is raised from the ureter and a specimen of the irrigating fluid collected for comparison and control. The procedure of course is not indicated in the cases either of negative bladder urine or of cystoscopic identification of renal bleeding.

The urological facts indicative of tumor which the several steps of the above examination may disclose are

Source of hæmaturia as renal reproduction of the pain observed clinically demonstration of disturbance in function demonstration by pyelography of deformity of the renal pelvis and identification of the tumor mass with the pyelogram. Calculus tuberculous hydronephrosis, many congenital renal malformations and so called essential hæmaturia may give bleeding without infection as usually occurs with tumor. Furthermore too much reliance upon the identification of small amounts of blood is unwarranted. It may come from the opposite healthy but congested hypertrophied kidney (Rovsing). Practically all of the infectious diseases may be associated with hemorrhage. Renal pain is dual in character the excruciating renal colic which radiates and the dull or sharp more continuous fixed ache. Movable kidney ureteral kinks idiopathic nephralgia from capsular adhesions or contractions etc. extrarenal or extra ureteral compressions in addition to all of the other

renal diseases may cause abdominal pain. Disturbances in the gall bladder, stomach, intestines, appendix, pelvis, and other organs give referred pains which may simulate renal pain. Appendectomy is a common treatment for nephropothesis. Unfortunately for diagnosis pain is not always referred to the affected kidney. In a recent personal case the patient's only complaint was of pain on the opposite healthy side, and peculiarly likewise, overdistention of the pelvis of the diseased kidney reproduced this pain on the healthy side. Marked overdistention caused a late colic on the diseased side never before experienced. Overdistention of the healthy pelvis produced pain confusingly indistinguishable from that suffered. Reproduction of pain upon overdistention must, therefore be analyzed critically.

Reduction of function bilateral or unilateral, occurs with many different conditions. The value of a functional study in any case is empirical and proportional to the care and accuracy used in its execution and control. However 39 of the 80 cases of tumor analyzed by Pleschner had separate functional study and all 39 showed a loss of function on the affected side. Deformities of the renal pelvis are difficult of interpretation. Certain errors in technique as partial distention uneven dilution with pelvic residual etc. extrarenal compression or temporary pelvic spasms and contractions (Case 15), and many other causes may produce distortions of the pelvic outline which simulate tumor deformity. Errors in the identification of the tumor found on examination with the position of the pyelogram may arise from overlying or closely associated tumor compressing the kidney but being unrelated (Case 14). In consequence each urological fact must in turn be analyzed with reference to other causes than tumor. If all other causes than tumor for the signs and symptoms prove negative clinically and if all other causes than tumor for the facts picked up by urological examination have been excluded a diagnosis may then be made. Completely negative urological findings will go far to discredit rather positive clinical ones.

so that a careful analysis of complete clinical and urological facts is essential.

The correlation of the combined findings pertains to four clinical groups of cases.

1. Cases with complete classical signs and symptoms which would alone render the diagnosis reasonably safe.

Cases with hematuria alone with abdominal pain alone or with hematuria and abdominal pain.

Cases with abdominal tumor the prominent sign.

4. Cases clinically indubitate in which the urological findings are suggestive.

Five cases of tumor which have been seen in the last two years illustrate some of the above points in diagnosis. With one exception (Case 5) they all fall in group 1, cases with complete symptoms. A diagnosis in such a late stage is not an early diagnosis. None of these cases are cured; 3 are dead, 2 living inoperable. It is not possible therefore to illustrate with these cases the relation of a clinical and urological correlation as advertised in the substance of the paper. It is early diagnosis of renal tumor. Other conditions in which the questions of kidney tumor are carefully outlined by way of illustrating the value of such a complete correlation. These three cases are of particular interest relative to the interpretation of their respective pelvic outline, inasmuch as pelvic deformity is the most positive urological evidence of tumor.

#### GROUP I. COMPLETE SYMPTOMS

CASE 1. No. 566 U. C. H. male age 50. Onset five to six years ago with morning muting which has persisted more or less irregularly to the present. Five years ago had an attack of pain in the lower abdomen which was dull in character and disappeared completely after two or three weeks. Six months ago he noticed that the hands were swollen and somewhat painful. Four months ago pain in the lower abdomen recurred and radiated to the back. The first attack of hematuria was two weeks ago. In the last two months he has lost forty-three pounds in weight. Examination reveals a large tumor in the right lumbar region. Clinical diagnosis of hypernephroma of the kidney was made and at operation a large inoperable tumor of the right kidney found. Autopsy showed sarcoma of the upper half of the right kidney with metastasis to the liver, pancreas and retroperitoneal and mediastinal lymph glands.

NOTE.—This report illustrates the great difficulty in early diagnosis because of the absence of leading symptoms. Period of onset of indefinite pain in the lower abdomen could not put the kidney under suspicion and the symptoms which could such as pain in the back and hematuria only appeared after the tumor was palpable and inoperable.

CASE 2. No. 026 U. C. H. female age 60. Onset three years ago with sense of fullness and discomfort in the right lumbar region. At this time the mass was palpable and has gradually increased in size with an increase in frequency and severity of abdominal cramps. It gradually developed weakness and emaciation. Six months ago first noticed blood in the urine. In the time as quite profuse and lasted about five or six days. There has been no change since.

Urine April 16. I. H. N. neg. Urine after 12 hours after red blood cells in urine no organs in urine albumin no sugar. Specific gravity 1.009. Urine phthalate nitrate. Urine albumin 45 per cent in 10 hours and ten minutes.

Cystoscopy. Bladder negative. Urine collected from the right ureter through rubber sheath shows few red blood cells. Urine occasional white blood corpuscles that from the left negative.

Ureter catheter. Right. A few polymorphous leukocytes. Left. No organisms.

Left. No pus. Few epithelial cells and a few red blood corpuscles.

Pelvic capacity right, 16 cubic centimeters (reproduced in right lumbar region) left 8 cubic centimeters (pain in the left side).

Supra-epinephrine phthalate intravenously. Right 4 minutes left 3 minutes.

First 15 minutes output right 6 cubic centimeters 4 per cent left 40 cubic centimeters 19 per cent.

Second 5 minutes output right 14 cubic centimeters 3 per cent left 35 cubic centimeters 9 per cent.

Bladder catheterized and no phthalate found in contents at the end of thirty minutes period.

Cystoscopy. Marked elongation and deformity of right renal pelvis left normal (Fig. 1).

NOTE.—In this case the clinical description of hematuria and emaciation and the marked deformity of the right renal pelvis correlated with the deformity of the right renal pelvis and the reproduction of the right renal pelvis on identification of the tumor and pelvic deformity. The diagnosis becomes more certain. Patient refused operation at this time.

CASE 3. No. 097 U. C. H. male age 43. Onset two months ago with dull steady pain in the left back. Has never noticed blood in the urine. On examination a large mass is felt high in the left flank behind the splenic flexure of the colon. The right side is negative. X-ray shows two stone shadows in the right kidney region and an enlarged kidney.

Cystoscopy. Left. A few polymorphous leukocytes. Left kidney to be functionless and only a few drops

of pus obtained from it. From the right (the side with stones) fair function and apparently normal urine obtained.

**Autopsy.** Carcinoma of the left kidney and left perinephritic abscess, hydronephrosis and nephrolithiasis of the right side.

**NOTE.**—This report shows the extent of renal damage that may take place before the onset of symptoms. The presence of stones in the opposite non-malignant kidney and their absence on the tumor side is of interest in view of the reputed causative influence of stones in malignancy.

**CASE 4.** No 91 P C male age 60 referred by Dr H C Moffitt with diagnosis of polycystic kidney. In 1900 had first severe attack of pain in the left hypochondrium which recurred ten years later and had been occasionally felt since then. This pain has never been severe enough to demand opiates never radiates never accompanied by urinary disturbances. A mass has been noted in the left side since 1910 which last year presented in irregular surface. A mass has recently become palpable in the opposite right flank. For the past ten years there have been varying periods of urinary frequency. At present the patient urinates three to four times at night but has no difficulty burning or dribbling. Two weeks ago had a rather severe attack of left sided pain followed in two days by blood in the urine the first attack of hematuria.

Examination shows a beginning prostatic hypertrophy small residual. Blood pressure 160 to 180.

Total phthalein test in January 1914, 42 per cent in two hours and ten minutes. On August 27 1915 38 per cent in the same time. Plain X ray negative except for enlarged kidney shadows. Bladder urine has been negative until the last two weeks when it has shown red blood cells microscopically.

**Functional study.** Urine from the right side is pale as compared to rather highly colored urine from the left. Injection of 6 cubic centimeters on the right side causes pain deep in the right back never before experienced. Injection of over 20 cubic centimeters on the left causes no sensation in the back. Specimens of each side negative microscopically except for occasional leukocyte found on the left.

Total phthalein test, right, 4 minutes left 7 minutes. First 15 minutes output right 52 cubic centimeters, 22  $\frac{1}{2}$  per cent left 66 cubic centimeters 5 per cent. Second 15 minutes output right 36 cubic centimeters 10 per cent left 54 cubic centimeters 5 per cent.

Patient taken to the X ray room and double ureteropyelogram taken (Fig 3).

**NOTE.**—The clinical evidence in this case indicating polycystic kidney receives definite confirmation in the urological study. The spider leg pyelogram is typical.

#### GROUP II HEMATURIA PAIN OR BOTH

**CASE 5.** No 238 P C male age 42. First noticed sensation of heaviness in the bladder in 1912 which caused a frequent desire to urinate. Careful examination of the urine at this time was

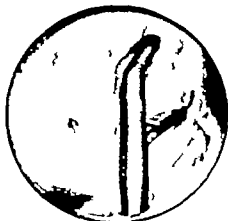


Fig 1. End of cystoscope in bladder mucin showing rubber sheath applied to ureteral orifice.

negative. These symptoms lasted for three or four months and completely disappeared. In June 1915 there was a recurrence of heaviness in the bladder and possible appearance of blood in the urine. On October 7 1915 patient definitely noticed the passage of three or four blood clots at the beginning of urination and two hours later suffered for two hours severe pain in the lower abdomen.

Physical examination negative. Neither kidney palpable. There has been some loss in weight and the patient appears somewhat emaciated.

X ray examination negative.

Total phthalein test 64 per cent in two hours and ten minutes.

Urine shows microscopically a few red blood cells no pus cells no organisms.

Examination for tubercle bacilli negative and a guinea pig inoculation negative six weeks later.

Cystoscopic examination (1916). Bladder negative ureteral orifices negative. No renal bleeding. Both ureters catheterized. Cultures of specimens negative.

Functional test unsatisfactory because of marked inhibition of function on the right side appeared on the left in less than four minutes. Ureteropyelogram not taken. Examination not repeated because of objections of patient who very soon after ward left San Francisco. The case has been followed however and in three to four months developed a large palpable tumor in the right side became cachectic and unable to stand an operation.

**Autopsy.** May 4 1916. Right kidney and suprarenal fused forming a tumor mass the size of a year old child's head consisting of tumor tissue surrounding the lower pole but apparently normal kidney cortex. Tumor white with brownish greenish and yellowish spots and streaks with central necrosis. Metastatic tumors in the left lobe of the liver and the lungs one on the left heart and one on the left suprarenal and a few in the left kidney.

**NOTE.**—The unusual onset symptom bladder discomfort and urinary frequency gave no indication of the renal tumor. Urine was negative except for the one attack of



Fig 1

Fig 1 Case 1. Normal pelvis. The minor calyces are clearly outlined and connecting directly to the pelvis. The major calyx is not dilated. Minor calyces and tubules are healthy. Major calyces are blunt and are a result of infection.

Fig 2 Case 2. Normal pelvis. The minor calyces are clearly outlined and connecting directly to the pelvis. The major calyx is not dilated. Minor calyces and tubules are healthy. Major calyces are blunt and are a result of infection.

Fig 3 Case 3. Normal pelvis. The minor calyces are clearly outlined and connecting directly to the pelvis. The major calyx is not dilated. Minor calyces and tubules are healthy. Major calyces are blunt and are a result of infection.

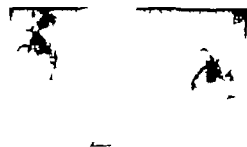


Fig 4

Fig 4 Case 4. Normal pelvis. The minor calyces are clearly outlined and connecting directly to the pelvis. The major calyx is not dilated. Minor calyces and tubules are healthy. Major calyces are blunt and are a result of infection.

Fig 5 Case 5. Nephropathy. The pelvis is dilated. Minor calyces and tubules are healthy. Major calyces are blunt and are a result of infection.



Fig 5

Fig 5 Case 5. Nephropathy. The pelvis is dilated. Minor calyces and tubules are healthy. Major calyces are blunt and are a result of infection.

Fig 6 Case 6. Renal tuberculosis. Marked dilatation of the ureter and pelvis. Extensive cystic degeneration of renal parenchyma. The calyces are dilated and the character of the ureter (which on examination as found contains pus and tubercle bacilli) indicated as inflammatory in origin. (See Fig 7)

Fig 7 Case 7. Hematuria. The pelvis is dilated. Minor calyces and tubules are healthy. Major calyces are blunt and are a result of infection.



Fig 6

Fig 6 Case 6. Renal tuberculosis. Marked dilatation of the ureter and pelvis. Extensive cystic degeneration of renal parenchyma. The calyces are dilated and the character of the ureter (which on examination as found contains pus and tubercle bacilli) indicated as inflammatory in origin. (See Fig 7)



Fig 7

Fig 8

Fig 7 Case 9 Grape cluster pyelogram (similar to Fig 6) typical of caseocavernous renal tuberculosis. Note marked ureteral dilatation in its iliac portion.

Fig 8 Case 11 Pyelonephritis with multiple abscesses. Ureter is dilated and nodular. Calyces are retracted and irregularly blunted. No evidence in pyelogram of abscess formation.

Fig 9 Case 12 Renal hypertrophy. No infection.

returned home and after heavy lifting hematuria recurred. Patient returned and double pyelogram made with negative findings (see Fig 4). Right pelvis again irrigated with adrenalin and finally with 1 per cent silver nitrate. Following the silver nitrate injection bleeding ceased and the patient returned home on April 28. In a letter July 17 he states that there has been no return of bleeding.



Fig 13

Fig 13 Case 13 Normal pelvis. The ureter sweeps out and over a large inoperable retroperitoneal sarcoma.

Fig 14 Case 14 Left renal abscess, suprarenal and retrorenal. Marked compression of pelvis and distortion of calyces from perirenal pressure simulating tumor deformity.



Fig 9

Fig 10

Fig 11

Bifid pelvis with unusual ramification and branching of both major calyces. Minor calyces indistinct (Compare Fig 8). Nephrolithiasis with complete destruction of opposite kidney. (See Figs 10 and 11).

Fig 10 Normal bifid pelvis. Minor calyces well outlined. (Compare Figs 9 and 11).

Fig 11 Normal bifid pelvis with pronounced branching. (Compare Figs 9 and 10).

NOTE.—The continuous profuse bleeding in this case contrasts markedly with the slight hemorrhage of Cases 2 and 5. The normal pyelogram gives a welcome assurance of the absence of neoplasm.

CASE 7 No 217 P C male age 40. Stricture of the lower end of the ureter. Slight hydro ureter and hydronephrosis. Perfectly well until Thursday night after a fifty mile automobile ride when he was



Fig 13

Fig 14

Fig 14 Peculiar pyelogram simulating renal tumor probably due to pelvic spasm at the time of the injection of the thorium nitrate but obtained at a second confirmatory examination. Clinical finding of tumor in the region of the right kidney which further confuses the diagnosis. Cystoscopic and functional studies negative.





function on both normal. Pelvic capacity of the right side was only  $4\frac{1}{2}$  cubic centimeters and 6 cubic centimeters of collargol injected by gravity through the ureteral catheter produced characteristic pain but which the patient is positive she has never before experienced. Pyelogram (Fig 14) shows three islands of collargol with a streak in the ureter below which picture might be interpreted as typical of tumor deformity. To avoid error a second pyelogram was made and proved to be identical with first. Exploratory operation by Dr. Terry. The most probable clinical diagnosis was hypernephroma. The evidence for this was two fold. The mass was evidently below the edge of the liver and apparently independent of it and the peculiar pyelogram which was obtained upon two separate examinations corresponded in position to this mass and in its deformity was typical of tumor. The complete absence of urinary symptoms, the absence of renal pain and the continued absence of blood in the urine and the normal renal function all suggested that the tumor was not connected with the kidney. At the exploratory operation the anterior portion of the liver was seen to be bent forward upon the main body of the liver which lay in the flank. This malposition allowed the different parts of the liver to move apparently independent of each other. The ptosis of the liver held up the right kidney so that it could not be palpated clinically but there was apparently no evidence of pressure on the kidney which would be the simplest explanation of the peculiar pyelogram. Probably pelvic spasms which prevented complete distention of the pelvis and ureter occurred at both examinations to give the distortion.

CASE 16. U. C. No 11,68, J. G. age 38 married. Admitted July 17, 1916. Complaint difficulty in urination due to blood clots in the bladder.

As long as 20 or 22 years ago patient noticed that the urine would be colored slightly red for two or three days at a time. This condition would recur every two or three months. There was no pain or other symptom associated with the appearance of blood. Eight years ago patient was seized with severe pain in the right lumbar region which radiated into the right testis and was accompanied with marked hematuria. For the next two or three years at intervals of about six months and lasting usually for a few days only the patient would pass numerous blood clots often accompanied with severe pain in the right lumbar region. During the past five years these attacks have occurred every three or four months. The patient has been under continuous medical supervision for about five years and two years ago he had a cystoscopic examination which, so far as known to the patient, gave negative findings. Upon admission it was not possible to get a total phthalein test because of the large amount of blood in the urine. Plain X-ray examination at this time showed irregular shadows in the region



Fig. 16. Sagittal section of tumor (Fig 15) shows the normal appearing lower pole of the kidney with the pelvis completely shut off by tumor encroachment. No bone or calcifications (teratomas) to explain shadows found in clinical X-ray examination. Probably shadows cast by dense masses of tumor degeneration as shown in the center of photograph.

of the right kidney which were suspicious of calcifications due to an old tubercular process.

Cystoscopic examination July 19. A blood stained stream could be seen to spurt from the right ureter. Bladder otherwise negative. Both ureters easily catheterized. The right side failed to function even after repeated stimulation with sterile water injection. It was not possible to inject more than three or four cubic centimeters upon the right side before the patient would complain of severe pain in the right lumbar region which simulated in position and character the pain of which he has suffered so long. The urine from the left side was negative except for a few red blood cells, microscopically and bacteriologically. Phthalein appeared on the left side in five minutes, output of 10 per cent in the first fifteen minutes. Double pyelography showed a perfectly normal appearing left pelvis and ureter, the major and minor calyces being well defined and negative, whereas, on the right side, even though the solution had been allowed to run by gravity until the patient complained rather bitterly of pain, no thorium could be seen in the kidney region and the ureter was outlined for only a short distance above the bladder.

On July 25 cystoscopic examination was repeated and the above findings of right renal bleeding of reproduction of renal pain and absence of right renal function were confirmed. A second attempt at this time to outline by pyelography the right kidney was again unsuccessful, no thorium being present in the kidney region even though the patient complained of considerable pain at the height of injection. Total phthalein on July 26: first hour 4 per cent, second hour 14 per cent, total of 56 per

This case has been seen and operated on since the publication of this paper. In April, 1916, but is now added for its considerable clinical interest.

ce t. X rays of the thorax and long bones were negative for evidence of metastatic nodules. Operated on July 27, 1928, and oxygen anesthesia. There was exposure by the lumbar route of a tumor which lay completely above the costal margin displacing the right lobe of the liver sufficiently to cause a momentary suspicion that the liver itself was being resected. Reassurance as immediately with extraperitoneal confirmation. The capsule of this tumor contained very large, eosinophilic channels (Fig. 5) each of which required ligation. The lower pole appeared to consist of normal kidney tissue but the upper four-fifths was irregularly nodular (Figs. 1, 2, and 6). There was apparently no tumor invasion of the hilum or of the renal sinus or the renal vein. The enlarged lymph glands at the pedicle were removed. Subsequent microscopic examination of the glands showed no metastasis. The tumor microscopically showed typical large, eosinophilic cells commonly characteristic of hypernephroma. Convalescence as uneventful. Total phyllopharynx August 1, first hour 38 per cent, second hour 16 per cent. Intestinal discharge July 28 to 31.

Notes.—The case presented symptoms of an usually long period of latency years before diagnosis was made. At the time of the cystoscopy, the patient had no clinical evidence of hematuria, but the patient had a history of microscopic hematuria noted upon examination but the finding at the urologic examination of renal

bleeding, reproduction of renal pelvis, absence of renal function and the clinical history indicated the necessity of nephrectomy. Such as above might be in all probability subsequent to the presence of renal tumor.

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## TUBERCULOSIS OF THE THYROID

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### HISTORICAL

IN 1862 Lebert described one of the first cases of tuberculosis of the thyroid gland. A few years later Cornil and Hanvier reported a case of general miliary tuberculosis with a tuberculous process in the thyroid gland. Charrin in 1878 found seven cases of tuberculosis of the thyroid gland among one hundred autopsies of patients that had died of some tuberculous infection and in the same year Dumolard reported a case of a fistula of the neck following a subacute tuberculous process of the thyroid. Virchow gave two cases of miliary tuberculosis and one case of caseous tuberculosis of the thyroid gland. Among the first authors to express the opinion that in general miliary tuberculosis there was always an involvement of the thyroid by the same disease were Cohnheim and E. Frenkel. Later Cohnheim described

8 such cases and E. Frenkel reported tuberculous involvement of the thyroid gland in all except 6 cases out of 580 autopsies of subjects who had died of general miliary tuberculosis. In 1890 Perry and Voelcker reported 4 cases of general miliary tuberculosis in children each of which showed microscopically tuberculosis of the thyroid gland. In the same year James Berry exhibited before the London Pathological Society a specimen from a case dying from miliary tuberculosis and it is interesting to note that on this occasion he stated that he was unable to find a specimen of tuberculous infection of the thyroid in any of the twelve large museums of London or those of Oxford, Birmingham, Newcastle, Edinburgh, Glasgow, Geneva, Berne or Zurich. This fact in addition to the limited number of cases of tuberculosis of the thyroid reported substantiates the



Fig 1. Case 5. Tuberculosis of the thyroid. There is a complete lack of normal thyroid tissue. The tubercle is isolated and surrounded by a cellular stroma.



Fig 2. Case 7. Tuberculosis of the thyroid. The stroma contains an isolated tubercle and an area of round cells.

opinion that most of the earlier authors failed to recognize tuberculosis of the thyroid gland.

So called primary tuberculosis of the thyroid gland was not described before the year 1890. Bruns was the first to recognize clinically a case of tuberculosis of the thyroid gland which he supposed was primary in the gland. On more critical examination of this case it was noted that the patient also had enlarged cervical glands and an involvement of the left apex. However no tubercle bacilli were found in the specimen. Fraenkel reported a case of tuberculosis of the thyroid which involved the trachea and oesophagus and resulted in a purulent mediastinitis. Schwartz described the case of a man age 30 with a swelling of the right lobe of the thyroid and with paralysis of the right recurrent laryngeal nerve. This case suggested malignancy. No tubercle bacilli were found but the microscopic section showed typical tuberculous tissue and a guinea pig injected with pus from the thyroid gland died of tuberculosis. No other focus of tuberculosis could be made out in this case. In 1902 Clermont reported a case age 2 which suddenly without fever developed enlargement of the neck that rapidly showed fluctuation

The incision demonstrated granulation tissue but no pus. The fistula became infected requiring a second operation at which time no other evidence of thyroid tuberculosis could be demonstrated. Rolleston reported a case of a man age 23 with caseous abscesses in the thyroid one of which ruptured into the oesophagus. The patient died of paraplegia due to curves of the spine. Some years later (1905) Lediard reported the case of supposed primary tuberculosis of the thyroid gland in a man age 21 who had lived in a goiter district. The enlargement of the thyroid and the elasticity of the tumor pointed to a diagnosis of fluid in a cyst. Cultures of the fluid from the cyst remained negative. Microscopic sections of the wall of the cyst showed tuberculous granulation tissue. The author writes: "In the case related there was no discoverable source of tubercular infection either prior or subsequent to operation." The patient has remained well and strong in all respects.

Virchow and Demme noted the direct extension of the tuberculous process from the surrounding organs into the thyroid gland. Grasset and Estor saw at autopsy direct extension of the tuberculous process into the



munity which the thyroid or even a goiterous patient, possessed against this disease. A goiter was even thought to protect the patient against tuberculosis. As a result of these ideas experimental work on thyroid tuberculosis was attempted by several investigators. Roger and Garnier, who were among the first of these investigators, injected an emulsion of tubercle bacilli directly into the carotid arteries of rabbits and guinea pigs and came to the conclusion that the thyroid gland could be infected with tuberculosis. In 1900, Torn injected an emulsion of tubercle bacilli directly into the thyroid artery of dogs which resulted in a marked infection of the gland in the injected lobe. On the other side, there was a marked proliferation of the epithelium but only once did he find tubercles in this lobe. He could not demonstrate tubercle bacilli in the colloid material of glands removed ten days after injection and because of the fact that micro organisms do not increase on adding thyroid extract to the culture media he was led to think that colloid destroyed organisms. Specimens examined from one to three days after the injection showed the bacilli in the colloid material to be granular and to stain much less heavily than the bacilli in the capillary spaces. After three days, many bacilli could be demonstrated in the capillaries and epithelial cells while only a few granulated forms could be made out in the colloid material. Pneumococci, typhoid bacilli and anthrax bacilli also were injected granular forms of which could at times be found in the colloid material after three days later than three days they could not be stained at all. From these experiments he came to the conclusion that the colloid material had an antibacterial action for the tubercle bacilli. Tomellini used rabbits and injected tubercle bacilli emulsion into the thyroid artery. He came to the conclusion that the progress of tuberculosis in the thyroid was like that of other organs, and that the elements of the tuberculous process in the thyroid gland of the rabbit were furnished by the blood stream. Shimodaira, experimenting with rabbits and using a constant emulsion of tubercle bacilli which he injected intravenously in decreasing

dilutions found that dilutions that gave a tuberculous infection of the thyroid, spleen, kidneys and testicles, when properly reduced would still give tuberculous infection in the spleen, kidneys and testicles though leaving out the thyroid. He came to the following conclusions:

1 The thyroid can become infected with experimental tuberculosis by the direct injection of small masses of tubercle bacilli just as other organs — the spleen, kidneys, and testicles — can become infected.

2 The susceptibility of the thyroid to tuberculous infection is less than in the other named organs.

3 The decreased susceptibility of the thyroid against tuberculous infection is probably united with the special functional activity of the organ.

In discussing the experimental results, Arnd expresses the idea that the method of Shimodaira was more nearly an index of the true relation of the thyroid to tuberculous infection than the work of Tomellini and Torn which he characterizes as being 'too energetic'. He is of the opinion that this evidence, associated with the relative lack of tuberculosis of the human thyroid as compared with other parts of the body, substantiates a relative immunity of the thyroid against tuberculosis. Arnd thinks that in miliary tuberculosis the whole body is so flooded with bacilli that the thyroid as the other organs is swamped; hence it is neither evidence for or against the relative immunity of the thyroid gland.

In connection with this review of the subject of tuberculosis of the thyroid gland, the writer has to offer for consideration the following material from the Crile Clinic.

CASE 1. Clinical diagnosis: exophthalmic goiter. White male, age 23, complained of goiter. The family history was negative. The patient had had the usual diseases of childhood, including scarlet fever. Seven years ago the patient had had an attack of appendicitis, being bedridden five weeks. One year previous to entry into hospital, the patient had been ill six weeks with inflammatory rheumatism. There was no history of chronic cough, expectoration, bronchitis, pleurisy, night sweats, dyspnoea, haemoptysis, or palpitation. The patient was subject to fainting spells and had lost 20 pounds during the past four months. About eleven months ago, the patient began to have a dull aching pain in the "small of his back," and at the same time, he noted dyspnoea, palpitation, nervous

ness and irritability. A few months later he noted an increase in the size of his neck. About eight months ago he had another attack of rheumatism keeping him in bed for 5 weeks after which his symptoms had increased. A course of rest and medical treatment was pursued for six weeks without improvement.

Pls I ex at lat I was som hat nervous I've signs nose mouth pharynx bear l ngs, abdomen and extremities negative Th trochlear and avillary glands case palp ill Th thyroid gland was palpall case ally the nigh lobe The gland was not r hard there e cystic areas and no pulsations

Operation Right lobectomy and ligatio of the  
 il up o thyroid artery. After operation  
 in d clopel marled all the il end y  
 al ope on the put t was lisch rpe l ith  
 mark d mpro enent of the y ptoma v h re  
 unction d

histological findings moderate hyperplasia  
tubular adenoma and hyperplasia

specimen consists of the right and the left lobes of the thyroid. Weight 37 gms. The capsule is thickened. On section the surface shows uniform grayish translucent tissue with an increase of stroma and nodules of diminution of colloid. The general appearance is that of glandular hyperplasia. There are no tumors.

[illegible]

Most of the follicles are very irregular in shape and size and contain varying amounts of eosin staining material. In some cases there are follicles that are filled with deep eosin staining material and are lined by cuboidal epithelium. Many of the follicles show infoldings of the lining epithelium which is of high columnar type. There are fields made up of thyroid cells, many of which are

without follicular arrangement and show little or no counterstaining material. There are also follicles containing giant cells with three to seven distinct staining nuclei but without tubercle formation.

In various portions of the section there is a complete lack of thyroid tissue pattern the tissue showing numerous conglomerate tubercles. In other portions the thyroid tissue is entirely obliterated and is replaced by fibrous tissue. In high power numerous small round cells. In this fibrous tissue there are multinucleated giant cells of the Lymphans type containing a necrotic center. Sterile quite regularly about the giant cells are epithelioid cells with pale staining irregularly shaped nuclei. The tuberculous process is definitely present.

CASE. Clinical diagnosis: goiter, exophthalmic, mild. White female, age , married mother of two children complained of nervousness and palpitation of heart. There had been several goiters in the father's family. The patient's general health had always been good. Three years previous there was a pleurisy of two weeks' duration. The eight or ten months previous was 14 pounds weight at the time of examination was 148 pounds. The symptoms of nervousness, palpitation and dyspnea began about one year prior to entry into hospital coming on after drinking beer or soft drinks and being intermittent and increasing in intensity especially at the menstrual period. The patient is unable to remain in bed for a short time. The patient had been very nervous and had much weakness for a long time until the patient was bedridden. The neck had begun to enlarge several years ago.

There was a slight ex-  
thral. The n k measured 35 centimeters.  
th right lobe of the thyroid gland was larger than  
th left lobe. There re no bruits or thrills or  
palpitations. areas. The heart was enlarged to  
th left systolic murmur as heard over the whole  
heart. At il level of the sixth and eighth ribs  
of the right back th was heard a friction rub.  
No murmurs of the pulmonary glands or of the  
thyroid glands as noted. The abdomen and th  
limbs were negative.

*Operation:* Lobotomy was performed without technical difficulty. The patient was much improved in general health when she left the hospital twenty days after operation. During the patient's stay in the hospital the blood pressure was 120 to 150 mm Hg mercury and the pulse as 90 to 114 beats per minute. There was an afternoon rise in temperature before and after operation from 99 to 101.

Pathological diagnosis: colloid goiter with colloid colloidoma and tuberculous.

(part of) Pathology No. 86 Specimen consist of a portion of the right the median and a portion of the left lobe of the thyroid gland Weight 6 gram The capsule of the gland is

slightly thickened containing enlarged blood vessels. The gland is soft uniform and lobulated. The cut surface is a pale reddish gray color semi translucent, and contains a small amount of colloid. There is a moderate increase of stroma. The general appearance is suggestive of a moderate hyperplasia. At the lower pole of the right lobe there is a calcified area about 1 centimeter in diameter which contains no recognizable adenomatous tissue within its capsule.

**Microscopic examination.** The microscopic section shows a lobulated structure an increase of stroma and a more or less diffuse round cell infiltration without germinal center formation. The round cells are more frequently noted in the fibrous trabeculae and they are not so numerous in the portion of the section where the follicles are more uniform in shape and size and where there is less fibrous tissue.

The follicles are rather small quite regular in shape and size, and well filled with deep eosin staining material and are lined by flat epithelium. There are no infoldings of epithelium into the follicles or other evidences of active hyperplasia.

In one portion of the section the follicles are markedly compressed and there is a great increase of fibrous tissue which shows a marked round cell infiltration. There are many small lighter stained areas which are made up of epithelioid cells and multinucleated giant cells with areas of necrosis and which have accumulations of round cells at the periphery. These typical tubercles are to be found in many fields. Another portion of the section shows a granular purple staining calcium deposit which has an area of homogenous pink staining bone tissue (containing bone cells) and which is surrounded more or less completely by a hyaline and fibrous connective tissue capsule. Inside of this capsule is an area of edematous fibrous tissue in which small atrophic follicles are occasionally noted. At the edge of the calcified nodule there are several typical tubercles. Other sections from the gland show no gross or microscopic tuberculosis.

The section with the bone formation may represent an attempt to encapsulate the tuberculous process by healing with bone formation or the bony deposit may be a part of the tissue changes of an adenoma which has been traumatized—an entirely separate pathological process from the tuberculosis with which it is in close association.

**CASE 3.** Goiter exophthalmic (?) White female age 18 single student complained of goiter. Family and personal history were unimportant. About two months previous patient noted an increase in the size of her neck, palpitation nervousness and slight tremor of the hands. Patient had been in bed for nine weeks previous to examination had gained in weight but had lost strength and felt weak. Patient had had eight weeks continual medical treatment with no improvement.

**Physical examination.** There was no exophthalmus. The neck measured 34 centimeters. The

thyroid was soft and freely movable there were no masses. The heart was enlarged the lungs abdomen and the extremities were negative. The lymph glands were not enlarged thymus enlargement could not be made out.

**Operation.** Lobectomy. In the operative note it was stated that there was an unusual number of lymphatic vessels running from the gland. Patient was discharged thirteen days after operation feeling much stronger. Before operation pulse ranged from 100 to 145 beats per minute after operation, pulse came down to 90. Blood pressure ranged from 105 to 130 millimeters mercury. Post operative temperature was 98 to 102.6° but was normal on day of discharge.

**Pathological diagnosis.** hyperplasia with tuberculosis.

**Gross pathology.** Pathology No. 11215. The specimen consists of the right and the median lobe of the thyroid gland. Weight 30 grams. The capsule is thickened the gland is lobulated fairly firm and reddish in color. On section the surface is uniform reddish gray and opaque. There is a slight amount of colloid present there are no tumors. Numerous opaque pin point areas scattered throughout the gland suggest lymphoid tissue. The appearance of the gland is that of a moderate glandular hyperplasia.

**Microscopic examination.** The microscopic section shows a lobulated structure a definite increase of delicate interlobular stroma, a marked increase of thin walled blood spaces and a diffuse infiltration of lymphoid tissue without germinal center formation. The follicles are very irregular in shape and size. Some follicles show marked infoldings to the extent of papillomatous like structures and are lined by high cylindrical epithelium but contain little or no colloid material. Other follicles have smooth walls they are lined with a low cuboidal or a flat epithelium and they contain fairly dense pink staining colloid with an occasional vacuolation and a shrinking away from the follicle wall.

Diffusely scattered throughout all the sections, there are tubercles made up of lymphoid cells and epithelioid cells with quite a definite wall of demarcation between the two types of cells. Occasionally multinucleated giant cells are seen in the tubercles. The pattern of the non giant cell containing tubercle is the same histologically as the giant cell containing tubercle.

All sections of the thyroid gland show a diffuse tuberculous involvement with a hyperplasia that is more or less localized in certain very small areas.

**CASE 4.** Clinical diagnosis. Struma of the thyroid. White female age 60 housewife complained of a growth on the right side of the neck. The family and personal history were negative. Sixteen years before examination the patient had had goiter which had disappeared after using iodine. Light weeks ago the patient had noted on the side of the neck a bean shaped nodule which grew quite rapidly to the size of a lemon but which did



not cause discomfort. The mass was quite hard, mobile under the skin but attached to the deeper structures and not sensitive or nodular. The thyroid gland was easily palpable but not markedly enlarged.

**Physical examination.** The chest was hyperresonant; there were dry rales heard over both upper backs. The heart was enlarged. The abdomen and extremities were negative.

**Operation.** Lobectomy. At the time of operation there was thought to be a malignant tumor of the thyroid. Blood pressure 120 millimeters mercury. Pulse 7 to 5 beats per minute. Temperature ranged from 97 to 99.5.

**Pathological diagnosis.** sarcoma and tuberculosis of thyroid.

**Gross pathology.** Pathology No. 11927. The specimen consists of the right lobe of the thyroid gland. Weight 4 grams. At the upper pole an embedded the thyroid tissue there is a large, gray hard irregular mass which 4 centimeters in diameter. The surface of the lobe is irregular, nodular and has some muscle tissue attached to it. The lower half of the lobe contains several soft and several hard encapsulated congenital dermoids. On the posterior surface there is a hemorrhagic cyst which is 1.4 millimeters in diameter and has a thick calcified wall. The original thyroid tissue is markedly atrophic. The section through the hard mass at the upper pole shows a central hyaline calcified area 4 centimeters in diameter which probably contained dermoid. A margin of tumor tissue to centimeter thick surrounds this calcified nodule. This tissue is uniform in appearance and of a translucent grayish color; no cellular debris can be expressed or scraped off from the surface. This tissue has the general appearance of sarcoma.

**Microscopic examination.** The microscopic section shows a definite increase of stroma with a round cell and a pus cell infiltration and increased vascularity. There are no germinal center formation. The follicles are irregular in shape and size. Some follicles are compressed, some well filled with deep staining colloid, others contain little or shrunken or vacuolated colloid, all are lined by cuboidal or flat epithelium, none show infoldings.

Most of the section is made up of tumor tissue, a small part of which is composed of round epithelial like cells arranged in columns and separated by very thin walled blood vessel spaces, while the most part is made up of a rather homogenous type of cells with an unusually large irregular nucleus which contains a red or a blue staining nucleolus and a diffusely scattered chromatin. The tumor tissue shows many mitotic figures. Here and there masses of deep staining colloid material without attached follicular epithelium are caught among the tumor cells.

Throughout the tumor tissue there are more or less circumscribed tubercles having a round cell infiltration about the periphery, epithelioid cells in

their characteristic arrangement and occasionally giant cells or areas of granular necrosis. This same type of tubercle can be demonstrated in the non-tumorous thyroid tissue. There are no intra-follicular tubercles noted.

**CASE 5.** Clinical diagnosis: exophthalmic goiter. White female, age 35, housewife, complained of bulging eyes. There had been several cases of scrofula in the family. Patient had always had difficulty in breathing through her nose, had had tonsillitis every winter and a cough for years. She perspired freely and had had night sweats often. One year before entry into hospital there was extensive loss of hair; four months later the eyes began to bulge. At the same time patient had had palpitation and increased nervousness. She became weak and easily exhausted and her hands and feet perspired freely.

**Physical examination.** On examination there is found a marked exophthalmus, a positive von Graef's, a Moebius and a Stelwag sign. The tonsils were large and nearly met in the midline. The heart was enlarged; the lungs were practically negative. The thyroid was symmetrically enlarged and there was a slight bruit. No tumors were palpated. There are numerous glands palpated, both sides of the neck and in both axillae.

**Operation.** Lobectomy without technical difficulties. Blood pressure was 130 to 155 millimeters mercury. Pulse varied between 90 and 30 beats per minute. Temperature was 97 to 98 with a slight evening rise during convalescence.

**Pathological diagnosis.** hyperplasia and tubercles.

**Gross pathology.** Pathology No. 11975. The specimen consists of the right median and a part of the left lobe of the thyroid gland. Weight 55 grams. The capsule is thickened and contains numerous large blood vessel spaces. Through the capsule the gland feels firm. On section the surface is reddish gray, lobulated, opaque, has very little colloid and has considerable increase in stroma. There is marked glandular hyperplasia; tumors are evident. The tonsils show lymphoid hyperplasia and slight chronic inflammatory reaction.

**Microscopic examination.** A part of the section shows marked increase of stroma, increased vascularity and a slight round cell infiltration without germinal center formation. The follicles are irregular in shape and size, containing little or no colloid and showing many infoldings and masses of thyroid cells which are of a tall columnar type.

Another part of the section shows minute tubercles closely packed together and separated by compressed thyroid follicles. Many of these tubercles have a more or less definite capsule which is composed of spindle shaped cells with long slender nuclei. These capsules containing epithelioid cells and occasionally a giant cell of the Langhans type separate the tubercles from the compressed thyroid follicles. The stroma shows a diffuse round cell infiltration without germinal center formation. In

this section the tubercular process is in the stroma no intrafollicular tubercles are noted

**CASE 6** Clinical diagnosis exophthalmic goiter. White female age 24 married complained of swelling of the neck. The patient had fairly good health as a child. Eleven years ago patient had had adenoids removed five years ago she had had an operation for goiter three years ago she had had rheumatism one year ago she had had pleurisy Duxey spells swelling of the feet and dyspnoea which compelled patient to sleep with head elevated were noted. There had been a loss of 23 pounds in weight during the past year. Eight years ago the goiter was first noted one year later there was exophthalmus dyspnoea palpitation and increased nervousness. The patient had had electric treatment and iodine treatment in the hospital without results. Two weeks after the first operation for goiter the patient had had typhoid fever for eight weeks after which time the neck again increased in size and the previous returned. There had been attacks of diarrhoea during the time previous to entry into hospital also increased appetite and weakness on exertion.

**Physical examination.** The skin was soft and moist and there was some oedema of the extremities. There was slight exophthalmus but no other eye signs were noted. In the median line there was a mass 3 x 4 centimeters on the left side there was a mass 7 x 8 centimeters in size. A thrill was felt and a bruit heard over the gland. The heart was enlarged the lungs were negative.

**Operation.** Seven days before thyroidectomy the left superior thyroid artery was ligated. At operation the thyroid gland was very adherent and part of it was below the clavicle consequently during its removal there was a brisk hemorrhage. During the operation the pulse reached 170 beats per minute. On discharge, the general condition with the exception of paralysis of the left vocal cord was improved.

**Pathological diagnosis** hyperplasia and tuberculosis

**Gross pathology.** Pathology No 12578. The specimen consists of part of the left and the median lobes of the thyroid gland. Weight 142 grams. The gland is firm the capsule is thickened and the vessels are markedly congested. On section the surface is uniform reddish brown opaque lobulated and shows here and there a slight amount of colloid. There is a definite increase of fibrous tissue and a moderate increase of blood spaces but no tumors.

**Microscopic examination.** The section shows a definite lobulation and an increase of interlobular stroma. There is also a definite increase in vascularity and an occasional accumulation of lymphoid tissue but no germinal center formation. The follicles are very irregular in size many are small, others are quite large all contain a pink staining colloid showing separation from the epithelium or showing vacuolation and all are lined by columnar or a high cuboidal epithelium. The histological

picture is that of a definite active hyperplasia of the thyroid gland.

In the stroma, there is found an occasional solitary tubercle but more frequently there are whole groups of tubercles which are scattered about large venous spaces. Among the groups of tubercles the thyroid follicles have disappeared to a great extent with the exception of a few epithelial cells which form the remains of a follicle. Throughout the tissue there is a round cell infiltration with a concentration of round cells at the periphery of the tubercles which are made up of large epithelioid cells and usually with a multinucleated giant cell. At the edge of the tubercular process there are a few intrafollicular giant cells. The picture in its entirety shows very little exfoliation of epithelial cells.

**CASE 7** Clinical diagnosis Goiter exophthalmic. White female age 38 housewife complained of goiter. Two brothers had had goiter and an aunt living in the same house had pulmonary(?) tuberculosis. At twenty two years of age the patient had kidney trouble. During childhood there were occasional attacks of tonsillitis otherwise the personal history was negative. About nine months before entry into hospital there was a slight swelling of the right side of the neck which increased gradually in size. The patient had lost 40 pounds during the last 5 months before examination. Nine weeks ago palpitation tremor and increased nervousness were first noted. Patient had become irritable weak, and had had some loss of hair. The skin was sallow and the bowels were constipated. There had been no vomiting diarrhoea increased appetite polyuria menstrual disorder erythema or acne hoarseness or cough. Eight weeks before examination patient had had medical treatment which consisted of diet rest digitalis and bromides and which had reduced the pulse from 160 to 120 beats per minute but had had no lasting result. Two years previous while doing heavy lifting patient had had an injury of her back, after which time there was noted an increased nervousness.

**Physical examination.** The eyes reacted to light and accommodation and there were no positive eye signs. Tonsils were small and atrophic. Nearly all of the teeth had been removed. The postcervical lymph glands were palpable but the scalp was clean. There was a definite increase of the right thyroid lobe and a slight increase of the left lobe. The thyroid gland was moderately soft, movable and not tender. A slight bruit was heard over the right lobe but there was no palpable thrill. There were no abnormal findings in the lungs. The heart was enlarged to the left and there was a systolic murmur at the apex. Abdomen and extremities were negative.

**Operation.** Partial thyroidectomy.

**Pathological diagnosis** hyperplasia and tuberculosis and adenoma.

**Gross pathology.** Pathology No 12766. The specimen consists of a part of the right the median

and part of the left lobe of the thyroid gland. Weight 50 grams. The capsule is somewhat thickened and shows numerous adhesions. On section the gland is made up of tumorous and non tumorous tissue. There are two adenomata of the congenital type, one is centimeters in diameter and the other is centimeter in diameter. Each of the adenomata is well encapsulated rather opaque and contains remnants of an old hemorrhage. Throughout the gland there are colloid degenerative nodules varying from 1 millimeter to 5 centimeters in diameter lightly encapsulated transparent and usually not pigmented. There are a few colloid retent on cysts varying from 2 to 3 millimeters in diameter. In the compressed thyroid tissue about the larger congenital adenomata there are pinpoint opaque dots not unlike fibrous scars or lymphoid calcifications.

*Microscopic examination* (grossly the microscopic section is made up of an encapsulated non lobulated adenoma and lobulated compressed thyroid. The adenoma is made up of colloid and non colloid containing follicles and large clear spaces. The compressed thyroid tissue takes a rather diffuse nuclear stain which suggests a thickened colloid infiltration.

The section shows that the compressed thyroid tissue is composed of an increased stroma with a diffuse round cell infiltration in some places. There are also numerous tubercles in the compressed thyroid tissue but there are none in the adenomatous tissue. The normal lobulation of the thyroid tissue is lost. The follicles are irregularly disposed they are usually of a fairly regular outline they contain deep or pale staining colloid and desquamated cells between them there has been marked vacuolation of the colloid and they are lined by a flat or a low cuboidal epithelium. Many follicles contain multinucleated giant cells the necrotic areas of which are usually indistinguishable from colloid masses of the original follicle. About the intrafollicular giant cells there are cells of the epithelioid type. Surrounding the giant cell containing follicles there is a definite round cell infiltration. The stroma also contains tubercles made up of multinucleated giant cells epithelioid cells and round cells. In fact much of the stroma has been replaced by tuberculous tissue. If the multinucleated giant cells and associated epithelioid cells are characteristic of a tuberculous process of the intrafollicular type then this section is made up almost entirely of the intrafollicular type of tuberculous.

In the adenomatous as well as in the non tumorous part of the thyroid tissue there are accumulations of lymphoid tissue but no definite germinal center formation.

Even after the microscopic demonstration of tubercles one cannot make out with any satisfaction areas in the gross which are tuberculous. Sections taken from some areas show tubercles while sections taken from others just as suggestive of tuberculous show none.

The specimen shows the difficulty of locating tuberculosis grossly and suggests that if all gross specimens were completely sectioned a much higher percentage of tuberculosis of the thyroid gland would be observed.

*CASE 8 Clinical diagnosis* hypertonus. White female age 47 music teacher. The patient had had fairly good health until the onset of the illness. At ten years of age the patient had sore eyes which condition was relieved by treatment. No history of cough expectoration or dyspnea were obtained. Present illness began about two or three years before entry into hospital with slight deafness throbbing headaches and specks before the eyes. Six months previously there had been a hemorrhage from the uterus. The uterus was removed and a fibroid tumor found.

*Physical examination* Hearing was somewhat diminished. Eyes reacted to light and accommodation but there was a slight clouding of the lenses. There was also evidence of an old keratitis and typical Hutchinson's tooth above. The reflexes are increased and there was a dorsiflexion of the great toe on stimulating the plantar surface on the left. The heart was enlarged the lungs were negative and the abdomen was negative. The blood pressure was very high systolic 180 to 220 millimeters and diastolic 30 to 135 millimeters mercury. The urine showed a trace of albumin and hyaline and granular casts.

*Operation* Thyroidectomy partial.

*Pathologic diagnosis* colloid goiter with tuberculosis.

*Gross pathology* Pathology No 12831. The specimen consists of part of the right the median and part of the left lobe of the thyroid gland. Weight 30 grams. The capsule is thin and shows no adhesions. On section the surface is lobulated translucent and of a pinkish gray color. In the center of the right lobe there is a nodule 3 millimeters diameter soft opaque grayish in color and is indefinitely circumscribed. The left lobe shows a similar nodule. These nodules suggest small fetal adenomata but the microscopic section shows that they are tuberculous foci. Further section of the gross gland demonstrates more of these structures which are tuberculous on microscopic examination.

*Microscopic examination* The microscopic section shows a lobulated structure. In the stroma especially near the capsule where the follicles are flattened there are accumulations of small round cells with no definite germinal center formation. The follicles are small well filled with deeply staining colloid and are lined with a flat epithelium. Scattered throughout the section there are follicles from which the colloid has disappeared and the lumina are filled with desquamated cells. Some follicles contain colloid which is thinned for some distance around the exfoliated cells. Other follicles

contain structures suggesting giant cells or exfoliated epithelium attached to clumps of colloid and also cells that appear microscopically not unlike epitheloid cells.

The opaque nodules which in the gross suggest fetal adenomata are histologically made up of giant-cells epitheloid cells and round cells. The giant-cells have multiple nuclei with a thin diffuse chromatin which stains moderately deeply and also an area of granular eosin staining material. Scattered throughout the tuberculous process are the epitheloid cells with pale nuclei irregular in shape and size, containing very little chromatin and not associated with a definite cell body. The small round cells with deeply staining nuclei without definite cell bodies are numerous around the areas of epitheloid cells. Within the areas of the tuberculous process there are entire follicles filled with colloid and surrounded by cuboidal epithelium showing that the process has advanced faster than absorption and replacement of the normal tissues has taken place. At the edge of the process the incursions of the colloid are more numerous and at the very edge there is an epitheloid cell formation and an accumulation of round cells in the stroma. Hence the process seems to be of an advancing type, rather than a quiescent type of tuberculosis.

**CASE 9** Clinical diagnosis goiter exophthalmic. White female age 32 housewife complained of nervousness of four months duration. The patient had had the usual childhood diseases and since then had been in good health. The cardio-respiratory history was negative. About four months ago while working very hard the patient noticed that she became unusually nervous and very irritable, a condition never noticed before this time. There was palpitation and extreme coughing spells which often ended in vomiting. One month later the patient had frequent crying spells, her menstrual flow became scanty and she lost weight. These symptoms with associated muscular weakness increased steadily, the patient consulted her physician three weeks before entry into hospital and was told that she had a goiter.

**Physical examination.** The patient was flushed and nervous. There was no exophthalmos or eye signs except a positive Stellwag's sign. The tonsils were enlarged. Moist rales were heard over the upper backs. The heart was enlarged to the left. There was a slight substernal dullness. There was a moderate enlargement of both sides of the neck and a systolic murmur heard over the thyroid gland.

**Operation.** Five days before the removal of the thyroid gland, the right superior thyroid artery was ligated. The operation uncomplicated by technical difficulties consisted of the partial resection of both lobes. Postoperative course uneventful. Patient left hospital in 2 days markedly improved.

**Pathological diagnosis.** hyperplasia with adenoma and tuberculosis.

**Gross pathology.** Pathology No. 12904. The specimen consists of the right and the left lobes of

the thyroid gland. Weight 36 gram. On section the tissue cuts with resistance. The tissue is firm, rubbery, lobulated, reddish gray in color and quite vascular. There are a few colloid retention cysts in some parts of the gland and in other parts there are areas about 3 millimeters in diameter which are nonlobulated slightly encapsulated and contain a yellowish crystalline deposit. The gland shows a definite hyperplasia.

**Microscopic examination.** The microscopic section taken at random from the gland shows an increase of stroma, an increased vascularity and an occasional small round cell accumulation. The follicles are very irregular in shape and size, they contain little or no eosin staining material, they show occasional infoldings of the lining layers and they are lined by a low flat or cuboidal or tall columnar epithelium. Some areas are made up of great masses of small follicles. The active hyperplasia is very irregular in distribution. No tumors are made out.

In one field of the section is a conglomerate mass of tubercles made up of a peripheral round cell infiltration, numerous multinucleated giant cells with areas of necrosis and a central area of granular necrosis. The giant cells are distributed about the central area of necrosis. Many epitheloid cells are seen among the giant cells making up the tubercle. This mass of tubercles is in an area of fairly marked hyperplasia.

The histological picture of tuberculosis is noted in only a few sections. Many sections were made from areas which were suggestive of tuberculosis in the gross but which, microscopically failed to show a tuberculous process. Some sections showed small conglomerate masses of tubercles.

#### CLINICAL DISCUSSION

The age incidence of the 9 cases is 33 years, the youngest being 18 years and the oldest (patient with malignancy and tuberculosis) 60 years. The average duration of goiter in the cases reported is fifteen months and the longest duration of goiter was sixteen years. One patient had not noticed goiter at all. Nervousness was complained of by 7 patients, the shortest duration being two months and the longest seven and one half years. Seven patients complained of palpitation, 3 had dyspnea, 1 having had it for eight years. Two patients had exophthalmos, 2 gave a history of tuberculosis and 3 had pleurisy. Fainting spells had been present in 3 cases.

On physical examination 6 patients had enlarged hearts, 1 had a friction rub at the left lower back, 2 had exophthalmos, 7 had a marked

during the past year. The average blood pressure of the 9 cases on admission was 145 millimeters mercury on discharge was 129 millimeters of mercury. Four patients had had treatment (2) 2 had had rest 1 had had digitalis and 3 had had iodine in 1 case applied locally.

The operation on all patients was a partial resection of the right median and part of the left lobes of the thyroid gland. Two patients had a ligation of one of the superior thyroid arteries this giving an index of the clinical severity of the disease.

All but two of the cases were diagnosed clinically as exophthalmic goiter. Cases 2 and 3 being diagnosed mild exophthalmic goiter. Case 4 was diagnosed sarcoma clinically. Case 8 was diagnosed hypertonus. It is remarkable that in no case was tuberculosis of the thyroid gland mentioned in the clinical diagnosis nor was tuberculosis suspected in the gross specimen after operative removal.

#### GROSS MATERIAL

On going over a tabulated list of the findings of the glands in the gross it was noted that the average weight of the thyroid tissue removed was 54 grams. Of the nine glands removed five showed a diffuse and more or less symmetrical enlargement of both lobes while four had tumors of various sizes and types. Three of the tumorous glands contained congenital adenomata while one gland was made up of sarcomatous degeneration. In no gland was the tuberculous process recognized as such at the time of removal. Not until histological sections had been made was the true pathological condition comprehended and even then in two of the cases the areas could not be located in the gross but only found microscopically by cutting numerous blocks from suspicious areas. Five of the nine specimens showed a more or less irregular hyperplasia two of which contained adenomata. Two specimens of the nine cases reported were colloid goiters.

According to the reported cases of tuberculosis of the thyroid gland which were removed at operation only the abscesses and large caseous nodular or conglomerate types have been recognized at operation or from the

gross specimen. In the 3 cases reported by Ruppanner the diagnosis was not made until the microscopic examination of the tissues had been completed. The author has found no reference to a malignant tumor associated with tuberculous infection of the thyroid gland.

#### HISTOLOGICAL DISCUSSION

For the absolute diagnosis of tuberculosis in the tissues it is necessary to demonstrate in that tissue the tubercle bacilli. This may be attempted by the staining of the tubercle bacilli in the sections of the tissues or by a digestion of the tissues by the anti formin method and a demonstration of the bacilli by subsequent staining. Both methods have been applied for the demonstration of tubercle bacilli in thyroid tissue. The earlier investigators using the method of staining bacilli in sections could not demonstrate tubercle bacilli with any degree of regularity in histological tuberculosis of the thyroid gland. L. Fraenkel after a careful search for the organism in the thyroid glands removed at autopsy said that tuberculosis of the thyroid usually showed itself by a richness of giant cells and a lack of tubercle bacilli. In only one of his three cases was Ruppanner able to demonstrate the bacilli. Schiller diagnosed a case of acute tuberculosis of the thyroid gland by the cystic tumor of the neck. In this case the tubercle bacilli were demonstrated. Roger and Garnier found many tubercle bacilli in a thyroid gland removed from a gravid who had an associated tuberculosis of the pharynx. Halstead did not find the organism in the case of thyroid tuberculosis which he reported. After a thorough search of the sections for tubercle bacilli Lediard was unable to demonstrate them. Hedinger has been fortunate with the anti formin method. According to his report of 10 cases including the 3 cases reported by Ruppanner in only 1 of which bacilli had been demonstrated Hedinger was able to demonstrate to his own satisfaction even when finding only a single bacillus tubercle bacilli in all but 1 of the 10 cases. By the anti formin method the author has been able to isolate granular shrunken acid fast structures from tuberculous tissue which

could easily be taken for tubercle bacilli but they were too greatly distorted to be positive proof of the presence of the bacillus.

Many of the cases of tuberculosis of the thyroid gland that have been reported either from the material at autopsy or from the operative clinic, have been diagnosed from the microscopical histological picture in spite of the lack of tubercle bacilli findings. Perry and Voelcker reporting 4 cases in children make the diagnosis by the microscopical histological picture. Ruppner could demonstrate bacilli in only 1 of his 3 reported cases and he expresses the belief that the diagnosis can be made from the histological picture without the demonstration of the bacilli. In spite of the fact that Lediard could not demonstrate tubercle bacilli in the sections and that cultures from the abscess cavity remained sterile and that smears stained for organisms gave negative results he made the following statement: "In spite of the non recovery of the tubercle bacilli the histological picture is typical of tubercular disease, and there can be no question of the nature of the disease." Corner expressed the idea that the tissues taken from the abscess wall of the thyroid in his case showed chronic inflammation and numerous tubercles. Hedinger thinks that in spite of the negative findings for bacilli from a sure and satisfactory histological picture one can make a positive diagnosis of tuberculosis. Halstead Arnd Pupovac also have made the diagnosis of tuberculosis of the thyroid gland from the histological picture without the demonstration of tubercle bacilli. In the author's cases the histological picture was taken as the diagnostic characteristic. The demonstration of bacilli while necessary for the absolute diagnosis is an ultimate refinement which is seldom used in the general work of a pathological laboratory where the histological picture is taken as evidence of tuberculosis. Three of the reported cases showed areas of tumor formation in the gross. The fact that in these 3 cases the tuberculosis process was noted histologically only in the compressed fibrous tissue about the adenomata, is in agreement with the statement made by Ruppner that the tuber-

culosis is to be found in the non tumorous portion of the gland. In no cases were tubercles found in the adenomatous areas in spite of the fact that the adenomata were not always of the colloid type.

Ruppner was among the first investigators to divide the location of the tuberculous lesion in the thyroid gland into interfollicular and intrafollicular types. The interfollicular is by far the more common of the two types and it is in histological structure not unlike the tubercle in other glandular organs but, in the intrafollicular type the picture is somewhat different. In a hyperplasia of the thyroid gland it is not unusual to see an interfollicular giant cell but the nuclei of these giant cells stain with the same intensity as those of the follicular epithelium and the space about the giant cell is not filled with cells that have irregular nuclei. In a section taken from a thyroid gland that has well defined interfollicular tubercles there are not unusually giant cells with an area of necrosis and occasionally engulfed colloid which have nuclei that stain more faintly than do the nuclei of the remaining parts of the follicular epithelium. Then too the space about the giant cells in these intrafollicular structures is usually occupied by cells that suggest epithelioid cells. Still another point is the fact that the intrafollicular tubercles are present in the adenomatous goiter and not in the hyperplastic gland. Ruppner demonstrated tubercle bacilli in these intrafollicular giant cells. To be sure that the intrafollicular giant cells are associated with tuberculosis the presence of the bacillus must be demonstrated. The report of Hedinger coming from the same laboratory as that of Ruppner states that he did not observe tuberculosis in the follicles without its involving the stroma also. Two of the specimens of this series show the intrafollicular type of tubercle.

The presence of lymphoid tissue in the thyroid gland has been a much discussed subject. DeQuervain thought that the increase of connective tissue the proliferation of the epithelium and the lymphocytic infiltration might be due to the tuberculous process or the result of a mixed infection. After study

ing the material from the clinics of Basel and Bern. Hedingcr was impressed with the increased number of cases showing lymph follicle formation with germ centers in the Basel material. Here also there was more tuberculosis of the thyroid gland. A Kocher after studying the thyroids removed at operation came to the conclusions that lymphoid tissue was more common in glands that showed desquamation, that the presence of round cells might be a reactionary or an inflammatory process and that the areas of cellular infiltration are always made up of lymphocytes and not pus cells and are occasionally found in glands with little or no desquamation and also in glands that are said to be healed. Von Werdt after examining 80 cases with marked lymphoid formation in the thyroid gland found that only 6 cases had not used iodine which was usually applied locally in the form of an iodine salve. Nine cases who used iodine did not show lymphoid formation while 6 that did not use iodine had lymphoid tissue in the thyroid gland. Atrophy due to (1) iodine applied locally, (2) pressure as from adenomata and (3) bacterial toxin influences as in tuberculosis are given by Von Werdt to be the main causes of lymphoid tissue formation in the thyroid gland.

Of the cases here reported all had more or less lymphoid tissue formation. Case 1 showed definite lymph follicle formation with germinal centers. Cases 2, 3, 4 and 5 showed rather diffuse round cell infiltrations and Cases 6, 7, 8 and 9 showed only an occasional accumulation of lymphocytes. Cases 1, 4, 6 and 7 had had treatment. Case 1 had had liquid medicine (1) and tablets (2) but only Cases 4 and 6 gave a history of using iodine. In these cases there is no definite relationship between the application of iodine and the lymphoid tissue found in the gland.

#### GENERAL DISCUSSION

Of the cases here reported Case 1 was the only male in the series. In the family of one patient Case 5 were several scrofula members while another patient Case 7 lived in a home in which a relative had died of consumption of years duration. Three

patients Cases 2, 6 and 7 gave a history of repeated attacks of pleurisy. On general physical examination Cases 1, 5 and 7 showed numerous enlarged lymph glands especially cervical and axillary. When realizing the extent of tuberculous disease the negative history and physical examinations of the other two cases does not exclude the possibility of an old primary focus of the disease. Hence it is doubtful if there is a true primary tuberculosis of the thyroid gland. Arnd was unable in the three cases that he reported to exclude by the clinical history or by the physical examination the possibility of a primary focus for the entry of the tubercle bacillus.

Since tuberculosis was not recognized in the gross glands and only located microscopically more or less accidentally, there are no doubt many cases of tuberculosis of the thyroid which would have been recognized if the glands could have been completely sectioned. The 9 cases here reported comprise a tuberculous involvement of less than one per cent of the operative material removed at the Crile Clinic; however this percentage would no doubt be higher if it were practical to examine histologically the whole gland.

#### SUMMARY

From the earlier pathological writings one is impressed with the idea that the thyroid gland is immune from the attack of the tubercle bacillus. As autopsy reports began to accumulate it was found that in acute miliary tuberculosis the thyroid gland did not escape infections. Tuberculous abscesses and conglomerate masses of tuberculosis in the thyroid gland began to attract the surgical attention and developed the idea of a primary infection of the thyroid gland. As the operative material increased tuberculosis of the thyroid gland was occasionally found histologically but it was practically never recognized in the gross. The tubercle bacilli are very hard to find in the histological sections and the diagnosis is not unusually made from the histological picture. Now that a larger operative material has been accumulated tuberculosis of the thyroid comes in for a definite and important per-

centage of the pathological lesions that are found in the thyroid gland and that percentage is even higher than has been shown by the pathological survey. Experimentally the work of Shumadina gave results which suggest a slight immunity of the thyroid gland in animals against the action of the tubercle bacillus. Primary tuberculosis of the thyroid gland which is established with difficulty is an unusual finding and most of the evidence suggests that the lesion in the gland is secondary to some healed or unhealed primary focus. The tuberculous process is associated with various physiological and pathological changes in the thyroid gland as hyperplasia, pure colloid goiter, adenomatous goiters, sarcomata or any combination of the before named conditions.

The author wishes to thank Dr. George W. Crile for the opportunity to report the above material from the Crile Clinic and wishes to express his appreciation for helpful suggestions from Dr. David Marine and Dr. Allen Graham.

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## PARTIAL GASTRECTOMY IN THE TREATMENT OF CHRONIC INDURATED ULCERS OF THE STOMACH<sup>1</sup>

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IT IS A GREAT honor that has been conferred upon me by an invitation to read a paper before this brilliant congregation of the ablest surgeons of a nation so prolific in men who specialize in this science. I am well aware that there is nothing new nor interesting that I can offer to this assembly, but I have accepted the invitation to address you as I wish to take advantage of this opportunity to give testimony as to all that I owe in my medical education to such men as Fenger, Coley, Hartley, McCosh, Bull, Halsted, Welch, T. Smith, Murphy, Rosenow, Keen (rule in), most particularly to that famous school conducted by the Mayo brothers at Rochester, Minnesota.

Although I have visited the best European clinics and have had the honor of meeting personally Kocher, Debove, Hartmann, Mikulicz, Trendelenburg, Eiselsberg, and Riedel, I am a firm believer in the teachings of the Rochester school concerning gastro-abdominal surgery. The constant reading and the translation into Spanish of many of the papers from the clinic and the knowledge gained from two visits to St. Mary's Hospital have convinced me that the teachings of the Mayo clinic must inspire each of us who loves his art. From this school I have learned in what an enormous percentage of cases indurated ulcers of the stomach degenerate into cancer and I extend to the brothers Mayo (2) and to Rodman (3) due credit for the impulse which has prompted me to advocate in my country the radical treatment of this lesion.

The first pylorotomy was performed in Chile twenty years ago. Later on, whether through lack of ability to diagnose the condition or the means to arrive at a diagnosis, whether the people were indifferent in regard to seeking treatment for such conditions or whether it had become an accepted notion among our physicians that cancer of the

stomach was incurable, the surgical profession was reduced to the mere surgery of traumatism wounds and some of the palliative operations. The very poor results following operations for gastric cancer contributed to maintain the vicious circle in which this branch of surgery was involved. The patients were all operated upon late.

If it is possible to cure by gastro-enterostomy duodenal ulcers in which malignant degeneration is an exception, will not the same operation produce the same results in similar lesions when located in the vicinity of the pylorus? In many cases, even with abdomen open, it is impossible to determine whether we are in the presence of an ulcer or of a cancer (Kuettnier 4). If gastro-enterostomy is done to cure gastric ulcer, one still is not sure that hemorrhage, subphrenic abscess, or the fearful cancerous degeneration will not occur. It is for these reasons that I advise and perform gastrectomy in those cases in which the general condition of the patient permits. After some experience with the methods of Billroth I, Billroth II, and gastroduodenostomy (Kocher), I have adopted and use the operation of Polya (5) as is described and recommended by W. J. Mayo (6).

I have performed this operation six times in the last thirteen months and have lost but one patient, an American woman who had suffered from gastric symptoms ever since she had been in the Philippines about six years before. She had become extremely emaciated. Incidentally, I will remark that in my country it is only the private patients who come late for operation. In some cases a voyage to Europe to consult specialists precedes the operation. Kuettnier, working in the cradle of European gastric surgery in the school of Mikulicz, makes exactly the same observation.

In all our patients the clinical manifestations of the disease have arrived at such an

advanced stage that it is useless to lose further time in laboratory examinations. It is absolutely certain that no other procedure than operation is possible in order to help these cases. We are following in that respect the ideas of B B Davis (7) that is that cancer is even more of an emergency disease than is appendicitis. Furthermore like Kocher Paterson and others I am convinced, that in those cases it is more dangerous to wait than to operate. If in accordance with the opinion of E. Owen it is an accepted fact that in doubtful cases of appendicitis laparotomy should be done to determine the nature of the disease why should we hesitate to employ the same method to establish our diagnosis in the upper abdomen? The exploratory laparotomy is still in my country the sovereign criterion to determine the procedure of the surgeon. Only some weeks ago I opened the abdomen of an old lady who had had gastric symptoms for many years. I was able because the patient was extremely emaciated to detect on many occasions a tumor no larger than a small nut. The operation revealed a gall stone in the common duct. I was not ashamed at all of this error because I was able to help my patient.

Tumor was palpable very easily palpable in all of our patients. I know quite well that induration of an ulcer may be present in a very few weeks and I do not ignore that the beautiful work of Mr A Thomson (8) Bird, and others who have shown that an extensive fibromatosis of the stomach may have no relation to cancer. When in doubt I give my patients the benefit of an operation. The indirect operation as Mr Bland Sutton (9) insists is an operation of another epoch because the disease remains and threatens the patient with its complications.

W J Mayo and Bland Sutton have called attention to the influence of sepsis and the appearance of the patient, indicating that they are suffering with cancer. The anemic appearance and the peculiar aspect which they present are in a great proportion of cases due to sepsis. In such patients it may be justifiable to follow the plan proposed by H Paterson (10) begin

with gastro enterostomy and if the patient cannot tolerate further intervention omit the second operation.

I followed this advice in the case of an extremely emaciated patient, who was terrified at the thought of a second operation. Following the practice of B Dawson (11) and Mayo I ordered the patient to be most scrupulous in the care of his mouth which showed much to be desired in this direction and following the principles of anoc association of Crile I was able to do what I do not hesitate to call an ideal gastro enterostomy. The result has been so good that the patient refuses to consent to a second operation. He seems to be quite well. The greatly indurated pyloric mass is still there pressing upon the biliary channels but after all it can be and I hope that it is no more than a fibromatosis which has developed in the vicinity of an indurated chronic ulcer.

In Chile we are far behind in the brilliant results obtained in North America with the X rays for the diagnosis of these lesions. We have not yet a uniform technique for their application. We have endeavored to introduce the direct method of L G Cole so beautifully followed in the most complete work of George and Leonard (12).

I have not yet had the opportunity to discover in my patients the secondary deposits in Douglas pouch to which G G Turner and Dr Palmer (13) have called attention. In some of our patients we have found the supraclavicular gland of Troisier Virchow enlarged and I have refused to operate upon these cases.

#### SUMMARY

Up to the present time in Chile we rely upon exploratory laparotomy as the final step in determining whether an indurated chronic ulcer (15) of the stomach should be treated by the indirect operation or by the most radical and rational method that is gastrectomy. We are in this respect a little in the same position as the English surgeons were in 1911 (14). I am a decided partisan of gastrectomy and all my preferences go to the operation introduced by Polya and recommended by W J Mayo.

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## CONGENITAL RADIO ULNAR SYNSTOSIS

1 WILSON WELLS, FORTYFID, M.D. M. POLLS, M.D. M.D. F.

at Surgeon Major pol. City Ho

**C**ONGENITAL synostosis of the upper ends of radius and ulna is of rare occurrence and shows a tendency to follow certain laws of heredity. In some 40 cases reported to date only 1 case was reported as successfully operated upon with restoration of the function of supination of forearm. A perfect result was obtained in this case only after a series of five operations.

In this type of deformity there usually occurs in both forearms from three to six centimeters of intimate union of the upper end of both bones and the power of supination is largely obtained through the muscles of the arm and shoulder. In view of the foregoing facts conservative treatment is of no value regardless of how early the conditions may have been recognized by the surgeon as even at birth the union is of such a consistency as to be beyond conservative measures.

This condition has received very little attention in this country and no case have heretofore been reported by American surgeons. This report includes two cases occurring in my service in the Minneapolis City Hospital mother and daughter both natives of Russia and very much alike in gross appearance and loss of function. The mother informs me that her father also a teacher in Russia had the same deformity.

**Heredity.** Regarding the strong hereditary tendencies it is interesting to note that in Abbott's (1) cases the deformity was met with

seven times in five generations. Blumenthal (2) reports it also present in a young sister the father and the paternal grandmother of his patient in von Sury's (3) cases the patient's sister mother and maternal grandmother were similarly affected.

I would here call your attention to a most striking tendency to heredity in the human as shown by Cushing (4) who has published a series of 302 individuals in which congenital union is of the proximal phalangeal joints occurred with 58 per cent of these in one family.

As the two conditions are of the same character a bony union of a joint in the upper extremity it gives a strong presumptive evidence of the hereditary tendencies in radio ulnar synostosis. This brings us to Mendel's law. Cushing's study through seven generations proves conclusively that this trait may be transmitted in its most outspoken form by a parent who appears to be slightly affected but never through parents both of whom are unaffected. His conclusions were that the trait behaves as a simple Mendelian dominant with equal chance among the offspring of affected individuals that it will or will not be inherited.

It is quite probable that these conclusions are applicable to radio ulnar synostosis.

**Clinical features.** I am certain that the deformity is often overlooked by the clinician however since the introduction of the X ray

as an aid in the surgical diagnosis its discovery is more frequent and it removes all doubt in its diagnosis. Textbooks do not even mention the condition which accounts for the lack of interest by the medical profession. The prominent clinical features in such cases are the inability to supinate the forearm the natural position of the hand being in pronation also the inability to lift objects of any weight. The patient is continually dropping objects and cannot receive articles in the palm of the hand for example a coin. Supination is done very largely by the action of the muscles of the arm and shoulder. This gives an awkward twisted movement of the whole upper extremity. They are unable to take part in most athletics and in wringing water out of a cloth the twisting power is weak and quite useless. The condition is known to exist from birth and the subjects feel their defect quite keenly and are loath to draw attention to the condition.

Movements at the elbow joints are as follows flexion normal while extension usually is not quite maximal the wrist joint movement is normal. On examination of the arm the upper posterior lateral sulcus corresponds to the position of the receded head of the radius.

On examination of the shaft of the radius which is much enlarged we note an effort of nature to preserve the lower wrist joint action by bending the radius outward making a wider interosseous space than normal. This bent club appearance of the radius is quite noticeable in both cases here reported. That the osseous union of the radius and ulna is firm can easily be proved by X ray plates as well as by the test of forced supination.

*Morbid anatomy.* There are two types of this deformity. (1) True radio ulnar synostosis in which the upper end of the radius is fused with the ulna for 3 to 6 centimeters. This bony union is intimate with no intervening compact layer between the spongiosa of the radius and ulna. Blodgett (5) describes this cancellated bone fusion as important in the cause of this deformity. Longuet and Peraire (6) describe by the term *ossification arciforme* the line of fusion extending obliquely downward on the front of

the ulna and its lower end usually has an accurate to correspond to the upper limit of the interosseous membrane.

Roskoschny (7) reverses the usual arrangement in reporting a case in which the ulna was stout and long and the radius slender and short. Appraille (8) describes a single case of synostosis of the lower end of the ulna and radius. The lower end of the radius and ulna are usually free. Wilkie (9) cites a case of lower end thickening of radius and ulna which he describes as a symmetrical thickening and suggests there is a tendency to a fusion of the lower ends as well as of the upper ends of these bones. In Case 2 here reported the mother showed this symmetrical thickening in both radius and ulna extending about 6 centimeters from the lower ends. Careful study shows that Case 1 the daughter has these same features. In Case 2 there is a linear fissure of the external surface of the lower radius leading to the wrist joint internal to the styloid process which suggests some former injury as a fracture. But this is denied in the history of the case. Its perfect symmetry in both radii would suggest that in her strenuous work there had occurred some tearing of the bony structure by muscular action much as we would explain a spontaneous fracture in a pathological condition.

The fascial and muscular changes are apparent. The supinator muscles are deficient and Dawson (10) reports a case in which the supinator brevis was absent. The axis of the flexors and extensors is altered and the pronators radii teres and quadratus are shortened. The interosseous membrane is usually narrowed in its upper part.

2 Synostosis with dislocation of the head of the radius is the other type of deformity and is more frequently met with.

*Etiology.* Lieben (11) states that this deformity belongs to a group of deformities of the osseous system characterized by disturbance in osteogenesis in isolated and frequently symmetrical sites in the body and that the defect whatever it be is transmitted in the germ plasma.

This lack of or delayed development of the radius may be the late appearance of the

ossification center in the proximal end of the radius hence it is possible that some inhibitory influence may be active at this prenatal period which may determine or cause these congenital anomalies and this is conceivably influenced by heredity.

In the embryo the usual position of the forearm is pronation but I have no cause to think that uterine pressure or any other factor would account for a solid and intimate union of these bones as was recognized by this mother in this case here reported who detected the deformity herself and tried to correct it during the first week of the child's life.

Bardeen and Lewis (12) found in the embryo at four and a half weeks that the radius and ulna were distinct below but fused above. Lewis (13) states further that at the sixth week of foetal life the distal ends of the forearm bones were distinct and separated from each other and that the perichondrium of the proximal end of the radius was continuous with that of the adjoining surface of the ulna. Lambertz law relating to these cases is as follows: In the extremities the ends which show a more elaborate development as regards shape have a less degree of growth hence as the radius does not develop in form it seems to increase in length.

**Treatment** There is in my mind no satisfactory treatment for a case of congenital synostosis of the upper ends of the radius and ulna.

Dawson's five operations on one patient with restoration of the function of supination was justifiable inasmuch as the patient was determined to get relief at all hazards. It is interesting to note that division of the bridge freeing the head of the ulna division of the interosseous membrane excision of the head of the radius with rotation of the bone segment 40 degrees finally gave the young woman a very useful forearm.

It will be important to note that Dawson was successful after the osteotomy of the radius at the junction of the lower and middle third by rotating the lower fragment 40 degrees. He held this position by the use of plates. This gave free use of the forearm as the patient could use the forearm in the

turning movement as in the use of the screw driver or playing the piano.

It should be noted that Dawson's five operations were pioneer work and in great measure necessarily experimental and that one of them the freeing of the head of the ulna accomplished no benefit. With the data gained from this case we can see that his four beneficial operations could be accomplished in one operation that separation of the head of the radius and division of the interosseous membrane with osteotomy and rotation of the radius are all that is required for successful restoration of the function of supination.

Of the other five cases reported operated upon the result in two was about 80 degrees rotation as will be seen in the following table.

Operator	Where reported	Operation	Results
Kammann	Bild et al. Abt. Chir. 18	Bony bridge divided	Not known
Moreau	Bell et al. Soc. Anat. Paris 1904	Removed head of radius and fused at the bony bridge	80 degree rotation
Stratton	Bird J 1903	Division of bridge and resection of head of radius	Great improvement
La		Division of synostosis	Lack of improvement
Schilling	Isaacs et al. Dermatol. and Surg. 1906	Division of bony bridge and extensor carpi radialis released	75 degree rotation in two months

In the case of the daughter here reported I was asked to improve her condition by the use of braces operation was not desired by either patient as neither considered themselves sufficiently inconvenienced to expose themselves to operative procedures.

I wish to express my gratitude to Dr Charles D Harrington for these excellent radiographs.

**CASE 1** Female age 15 school girl. Nativity Russia. Came to hospital from gymnasium on account of deficiencies in arm movement. This impairment was first noticed by her mother when she was only a week old. The mother had made an effort to correct the deformity but failed. The patient knew her condition in childhood as she could not play jack stones and would let things drop but was anxious to get along without being noticed in her defective movements. She can play the piano and do most things other children do and at present is employed as a clerk in a department store. Here

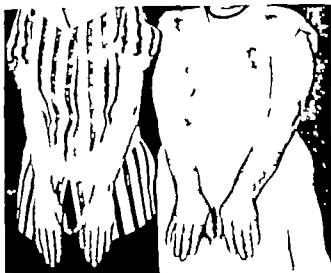


Fig 1 Case 1 (at left) To show natural position of forearm in pronation. Note the narrow outline of upper forearm with well marked sulcus on posterior aspect of elbow.

Case 2 Same position of pronation in the mother. To show characteristic contour of forearms. Wide lower forearm and narrow upper forearm. Note ulna on posterior external aspect of elbow.

she is continually dropping articles. Had typhoid at eight and made a good recovery. Family history negative except mother has similar condition.

**Examination.** Muscular development of arms and forearms above the average. No marks or scars around elbow joints. The contour of the forearms was quite distinctive. In the position of full pronation her natural position the narrow outline of the upper end of forearm due to the retracted head of the radius, was noticeable. In this position a sulcus is produced.

Outward rotation of the shoulder joints gives a twisted position which makes possible the limited supination of the forearms. By special effort to rotate she secures a maximum amount of supination as follows: right 45 degrees, left 60 degrees. Due mostly to action of the shoulder joints. The palmar surfaces were approximated only by effort from the shoulder. Circumduction at the shoulder is not perfect being impeded in full extension. The elbow joint is not perfect there being an extension of only 160 degrees. Flexion normal. Flexion and extension of wrist normal. In the act of taking a coin she rotates the forearm from the shoulder. In the effort to effect supination to receive a coin she must take it between the thumb and index finger being unable to turn palm uppermost as is the usual way of receiving money or other objects. In the test of placing finger tips to chest with the dorsal surfaces of hands in apposition the wrist forming an angle of 90 degrees the best she can do is to place the hands on the chest in the awkward position shown in Figure 3. The roentgenograms show solid bony union of 6 centimeters of upper ends of radius and ulna. The



Fig 1 Case 1 (at left) Maximum supination secured by rotating shoulder outward the patient in act of grasping a coin.

Case 2 Maximum supination secured by rotating shoulder out and the patient in act of grasping a coin.

shaft of the ulna is slender and straight while the shaft of the radius is stout and curved as if pushed away from the ulna causing the interosseous space to be abnormally wide. There is a slight enlargement of ulna and radius for about 5 centimeters from lower ends. Both forearms are practically identical and there are no other abnormalities in the body. The grasping and lifting strength is practically lost with the arms in extension.

**CASE 2.** Female aged 42, house wife. Nativity Russia. Mother of Case 1. Came to hospital with request that I give daughter relief of her deformity by use of braces. She knew her own condition and has always worked hard when washing she had great difficulty in wringing the water out of clothes. She has very little twisting power in the forearms.

She is the mother of five girls and one boy and after careful examination I was unable to detect any abnormality in any but the case reported above.

One especially interesting feature is that she reports that her father who died in Russia aged 62 years had the same condition. He followed teaching and was unable to supinate his forearms. The fact that for three generations this deformity existed is proof of its hereditary tendencies. In the two cases here reported their actions, deficiencies, and anatomical pictures are so similar that to report the mother's case is a repetition of Case 1. She is very sensitive regarding her deformity and is superstitious about it.



Fig 3 Case 1 (at left) Forearm in position in attempting to approximate dorsal surfaces of hands with wrist forming angle of 90 degrees.

Case 2 Forearms in position same position as in Case 1.

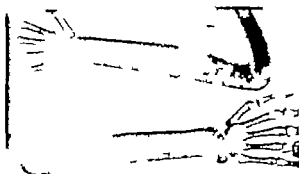


Fig. 4. Roentgenogram of Case 1.



Fig. 5. Roentgenogram of Case 2.

*Analysis:* Muscular development of arms and forearms usually large. There are no traces of former injury or disease in the neighborhood of the elbow or distal joint. The usual degree of rotation of the heads of the radius is very noticeable. This also gives the narrow outlines of upper forearms.

Outward movement from shoulder action gives about 55 degrees of supination of both forearms. Circumduction of shoulder joints impeded at full extension.

Extension of elbow joints is 60 degrees. Hyperflexion of elbow joint is normal. The wrist actions of flexion, extension and outward and inward rotation are normal.

In her action of receiving a coin, she shows the same awkward movement of twisting the whole upper extremity from the shoulder. This same awkward movement is again shown in the chest position.

In the radiographic study we notice the same general landmarks as in Case 1. However, in close study there are interesting differences. Union of upper radio-ulnar 5 centimeters or 1 centimeter less if not than in Case 1. The union is firm and makes a solid upper forearm and there is no outward rotation from the upper radio-ulnar articulation. The outer edge of ulna is usually straight and there is a thickened outline of the

lower 6 centimeters of ulna. The radius appears pushed away farther from the ulna than in Case 1, thus forming wider interosseous space. The irregularly enlarged (club-like) appearance of the lower end of the ulna and radius is interesting as compared with the smooth outline of the lower end of the ulna and radius in Case 1. Again it will be noticed that the synostosis in the right and left forearms is identical and the patient suffers the same lack of function in both arms.

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## THE GROWTH OF FREE BONE TRANSPLANTS

## AN EXPERIMENTAL STUDY

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OLLIER'S view (23) that bone transplanted with its periosteum can survive was overthrown when Barth (6) advocated that according to his experiments transplanted bone entirely loses its vital power and is replaced by newly built bone tissue. Therefore it would seem that dead or living bone transplants may be used without altering the process of bone regeneration. Since then the consensus of opinion is that the fate of the transplanted bone is not so extreme as Barth declared. The bone tissue should be kept covered with its periosteum preferably as fresh as possible and autogenous transplants should always be used to attain the best results in bone transplantation.

While the question of the fate of transplanted bone and the problems associated with it are not quite settled, the use of bone transplants is increasing year by year and is fulfilling its clinical aim. The cases of Prof. Dr. Sumita, which he published in the transactions of the fifteenth Japanese surgical congress, are so interesting that it might be well to describe the growth of the transplants in these cases.

I examined changes which took place in every part of the bone. If osteogenesis of transplanted bone were a matter of fact, its growth might be imagined too, and in this relation all my experiments were with the epiphyseal line in young growing animals.

Since changes of the transplanted bone took place in a short time after the transplantation, as Frangenheim said, I should like to make a preliminary report of the early experiments at this time.

Here I wish to thank Prof. Dr. Sumita for his kindness in suggesting this theme to me and for his help in writing this article. He has shown me a case of transplantation in an animal which might be considered as evidence not only of a surviving transplant but of its growth.

## METHOD OF EXPERIMENT

The animals used for these experiments were young dogs 1 and 2 months old. Under strict asepsis I freed an entire radius from its surrounding tissue, removed it and then replanted it into the same dog in an inverted position or it was exchanged with a similar bone of another dog, placing it here also in an inverted position. In the operation I avoided trauma to the surrounding tissue. Concerning the periosteum I conserved it entirely with the transplant but sometimes before the transplantation I stripped it off entirely with a knife after removing the transplant from the body.

In every case before the operation roentgenograms were taken and repeated after the transplantation at certain intervals to observe changes in the transplanted bone. The experiments were completed in from 11 to 63 days after the transplantation. The transplanted bone after being removed from the body was fixed in formalin solution, nitric acid formalin or Zilkens' decalcifying solution. celloidin sections were made and stained with hematoxylin-eosin or with iron hematoxylin.

## RECORD OF THE EXPERIMENTS

EXPERIMENT 1. Replantation of the left radius with periosteum examined 11 days after the transplantation in a dog two months old, weight 2170 grams.

Under general anesthesia with ether through an incision over the entire length of the left forepart of the front leg the entire radius was made free and removed. Thereby injury of the periosteum and epiphysis was almost entirely avoided. This bone with its periosteum was replaced in an inverted position. At the time of the operation the radius was 6.5 centimeters long. After the operation a mild suppuration took place in a part of the wound.

Examination 11 days after the replantation. Macroscopical appearance of the transplant. The entire upper epiphysis (in the transplanted position) and the upper part of the diaphysis at the lateral surface were grown fast to the surrounding tissue. The upper epiphyseal line (in the transplanted





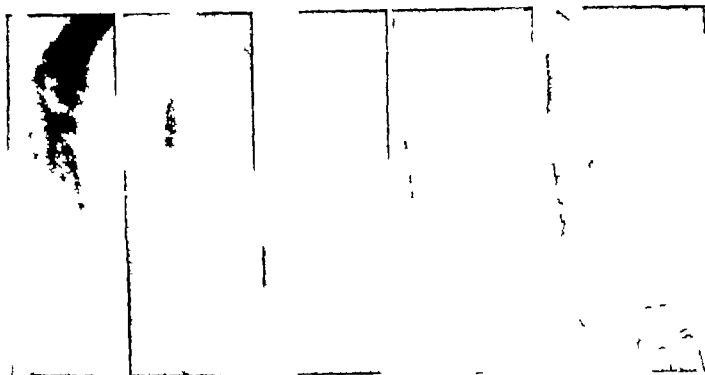


Fig 3

Fig 4

Fig 5

Fig 6

Fig 7

Fig 3 Experiment 6 Before the transplantation  
Fig 4 The end of the second week after the transplantation

Fig 5 The end of the fourth week after the transplantation

Fig 6 The end of the sixth week after transplantation The upper and lower epiphyseal lines are not changed

Fig 7 The end of the eighth week after transplantation

ficial layer of the cortex) there were found many cells but no degeneration. Cells in the epiphysis showed no degeneration and in various places very clearly stained cells were arranged in groups suggesting cell proliferation. Most of the bone substance of the ossifying nucleolus in the middle of the epiphysis remained but the majority of the bone cells lost their nuclear staining power. In this region cells were seen entering into deep tissues from the periphery. These cells consisted of two forms, the polyblasts and the spindle or star-shaped cells. The cortex had many new vessels entering from the periphery and was rich in cells. Here spindle and star form cells built a coarse network in which were found many polyblasts. The deeper the layer the greater the diminution of the number of cells and in the deeper layers erythrocytes were mixed with other cells with nuclei that have been extravasated in the mass of detritus. In the deepest parts were found neither cells with nucleus nor erythrocytes. In the interlamellar spaces spindle or star form cells formed the basis of new tissue. In some places were found many enlarged polyblasts. No spindle form cells that had entered into the bone substance could be found. Most of polyblasts lay near the pre-existing bone and a few of them had entered it. As yet no sign of ossification could be found. The cells of the epiphyseal line showed a very beautiful direction phenomenon but no degeneration.

In the diaphysis the blood vessels and connective tissue had entered into the interlamellar spaces of the superficial layer. In the enlarged interlamellar spaces giant cells were to be found. But as yet no new building of the bone tissue was seen. Most of the original cells had changed their ability to take stain but in the superficial layers many cells were found that showed no such changes. In the depth of the marrow the marrow cells and blood vessels lost their nuclear stain, and in this part we could find neither new blood vessels nor new tissue. Near the lower epiphyseal line no new cells had entered. Most of the cells of the lower epiphyseal line had disappeared but very few of them remained. However these cells showed no changes. At the border of the lower epiphysis no changes were to be found although most of the cells in the central ossified part were degenerated and some of them were necrotic.

EXPERIMENT 3. Replantation of the right radius with periosteum examined 14 days after the transplantation in a dog two months old weight 2.597 grams.

Using the same method as in the former case the whole right radius was replanted in an inverted position. The periosteum was kept intact. At the time of the operation the length of the radius was 7.7 centimeters. A few days after the operation the animal walked using the leg operated on. The wound healed primarily. Extension in the

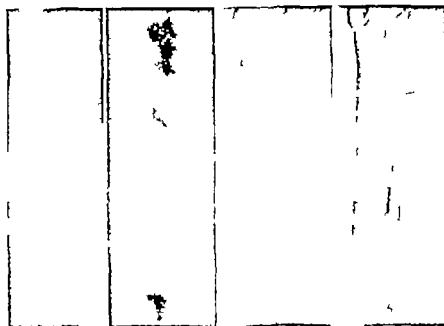


Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 9. Before transplantation. The end of the fourth week after transplantation. The end of the fourth week after transplantation. The end of the fourth week after transplantation.

Fig. 10. Before transplantation. The end of the fourth week after transplantation. The end of the fourth week after transplantation. The end of the fourth week after transplantation.

ubital joint in the rat operated on was normal and the leg could bend the leg operated on in this joint to a right angle.

Examination 4 days after the transplantation. Macroscopical appearance of the transplant. A vertical section of the whole bone showed a pale bluish color not the color of normal marrow. The color of the epiphyseal line was normal. Where macroscopically no loss of bone tissue was found. Beneath the joint surface of the upper end of the transplant was found growing bone.

Microscopical appearance of the transplant. The periosteal and subperiosteal layers showed degeneration and they were rich in cells. In the middle of the diaphysis a few new bone tissue which was growing from the periphery into the substance of the transplant. The newly built bone tissue was stained brightly. The staining of the pre-existing bone was less intense. The new bone tissue had entered into most of the interlamellar spaces of the pre-existing bone. Three kinds of these cells were distinguishable: (1) a

spindle cells from (2) different forms showing from small round to polygonal small or large (the former are supporting cells and are indistinguishable in their morphology from the common fibroblasts, the latter are phagocytes and are indistinguishable from the polyblasts) (3) giant cells which resemble a group of polyblasts. The cells of the polyblast form and others with the form of fibroblasts appear at the same time in the interlamellar spaces. Perhaps the cells of the fibroblast form built the new tissue while the polyblasts destroyed and resorbed the pre-existing bone tissue. If this process is advanced the interlamellar spaces enlarge by gradual disappearance of the old bone lamellae and are occupied by new connective tissue. At this time tissue rich in cells appears which centers about blood vessels. This tissue builds a network by its connection and changes into the normal character of bone lamellae following the appearance of small bone bodies and cells therein with an increasing ability to stain (Fig. 13).

The first cells which make connective tissue around the blood vessels and the cells which grow into the bone lamellae have the same form so that no morphological difference can be found between them. During the epiphyseal line the new building of bone decreases more and more and almost all of the marrow cells and bone cells have lost the staining power of their nuclei. The cells of the epiphyseal line show no retrogressive changes but

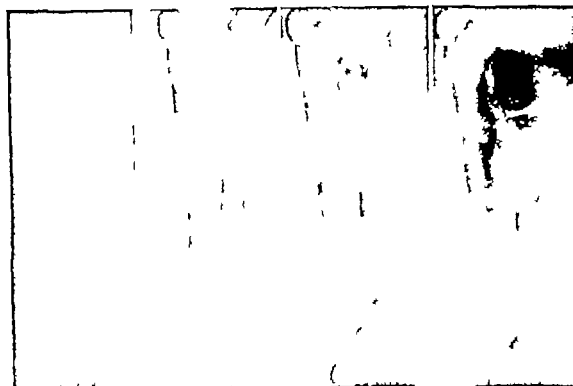


Fig. 12

Fig. 13

Fig. 14

Fig. 15

Fig. 12 Experiment 8 Before the transplantation

Fig. 13 The end of the fourth week after the transplantation A slight depression is seen in the ulna opposite the upper end of the transplant

Fig. 14 The end of the sixth week after the transplantation

Fig. 15 The beginning of the ninth week after the transplantation

in the ossification center the marrow cells have entirely lost the staining power of their nuclei

**EXPERIMENT 4** Transplantation of the right radius (homotransplantation) with periosteum examined 10 days after the transplantation in a dog two months old

By the same operative method as in the former cases the right radius of one young dog was exchanged with a similar bone of another young dog and transplanted in an inverted position with the periosteum intact At the time of the operation the length of radius was 6.5 centimeters A few days after the operation the dog used the leg operated on but walked with a limp The operative wound healed primarily but the wrist joint became flail like

Examination 10 days after operation Macroscopical appearance of the transplant The vertical section of the transplant appeared pale and whitish and showed no places having color of the normal marrow The epiphysis had normal color and we found no resorbed places on the surface of the transplant Between the upper end of the transplant and the joint surface of the lower end of the humerus there was no union

Microscopical appearance of the transplant No degenerative changes of the periosteum were present In the subperiosteal layer the cells in some parts were degenerated but in other parts were

well conserved These parts usually are rich in cells Most of the marrow cells show a tendency toward degeneration and occasional weakly staining bone cells remain Near the epiphyseal line in the diaphysis cells which had entered into the transplant were very scanty and they were found in groups only in the periosteal layer Cells were progressing from this part into the deeper layers of the transplant In the middle of the diaphysis blood vessels and accompanying cells had entered from the surface into the deeper layers of the transplant Occasional giant cells were found In some parts new bone tissue had formed in the cortex the latter showing new bone lamellae Yet in the newly formed interlamellar spaces the proper marrow cells had not appeared In this part we did not find cells entering into the marrow Cells of the cartilage of the epiphysis show no degeneration In the central ossified parts most of the cells were degenerated but a few of the cells conserved their nuclei weakly stained

**EXPERIMENT 5** Homotransplantation of the left radius with periosteum, examined 20 days after the transplantation in a dog two months old weight 1216 grams

By the same operative method as in the former cases the whole left radius of a young dog was exchanged with a corresponding one of another dog of the same litter and transplanted with the periosteum



the transplant within 20 days it has showed a pale whitish color) At the transplant the surface toward the skin was smooth but that toward the ulna had an area at which a tissue like connective tissue had entered into the transplant. The cavity of the cubital joint, on the radial side was nearly filled with a connective tissue. The above described tissue entered into the transplant and was a part of this tissue. The surface opposite the interosseal line was also slightly uneven. The vertical section of the upper epiphysis was divided at the lower thirds into lower and upper part by a tissue which had the appearance of cartilage.

Microscopical appearance of a whole vertical section of the transplant. The upper epiphysis. The greater part of the upper epiphysis consisted of tissue already ossified and the central part of the upper end was occupied with a connective and cartilage tissue. These two tissues were just beginning to ossify. At the junction of the ossified zone we found two kinds of tissues the normal connective tissue and the cartilage tissue and we could make out a part of the ossification of the cartilage and of the connective tissue in the same field. Also there is a curved strip of cartilage entering from one side of the epiphysis. Nowhere in this cartilage was found tissue showing the normal construction of the epiphyseal line. In the subperichondral layer we found a completely ossified part and another one just ossifying. In the marrow substance of the ossified part the cells lying in the interlamellar spaces had a normal appearance. All this cartilage tissue above described corresponds to the thin shadow in the X ray photograph. (This part showed a disappearance of the bone substance but perhaps it was true that this thin shadow might be interpreted as an irregular proliferation of the cartilage tissue.) The condition of the ossification gives us the idea that this cartilage tissue would soon have ossified and united. The increasing of bone shadow in the X ray examination perhaps demonstrates this fact.

Diaphysis. There is a small part of the cartilage which had not quite ossified. The cells in the interlamellar spaces and the bone cells were normal except it was rich in the interlamellar substance and in consequence the interlamellar spaces are smaller than those of the normal.

The lower epiphysis. We find a curved line like zone in a part which corresponds to the location of the common epiphyseal line. The ossified part below this zone is hardly as wide as one third the entire lower epiphysis. Another large part consisted of rapidly ossifying cartilage. At some places in the zone of ossification, we found a view like the direction phenomena of the normal epiphyseal line. As it neared the outward side this cartilage tissue became a connective tissue at the periphery it extended into fibrous membrane, and between them we could find no difference in appearance.

To sum up in this case, the transplanted bone has grown in very well. In the X ray examination

at the end of the fourth week we found in the lower end of the diaphysis indications of bone resorption, but the microscopical examination showed instead that there had been an irregular proliferation of the cartilage tissue which had ossified within a few weeks. The whole transplant had increased in thickness but not in length.

The microscopical examination showed two tissues irregularly mixed, one ossified and the other undergoing ossification. The upper and lower epiphyseal lines could be found by both the macroscopical and the X ray examination but the microscopical examination revealed an absence of a normal epiphyseal line structure.

EXPERIMENT 7. Replantation of the right radius with periosteum examined 60 days after the transplantation in a dog two months old weight 2700 grams.

By the same operative method as in the former cases the right radius was removed from the body and replaced with its periosteum in an inverted position. A few days after the operation the dog used the leg operated on but walked with a limp. The wound healed by primary union. At the time of the operation the length of the radius was 7 centimeters. Before the death of this animal the forepart of the front leg was the same thickness but was shorter than that of the opposite side by 1.5 centimeters. Both flexion and extension of the cubital joint were normal but rotation of the foreleg was impossible. In walking the dog touched the floor with the entire part below the wrist joint of the side operated on flexing this joint to a right angle. This animal limped till its death but walked very actively using the leg operated upon.

X ray examination end of the fourth week. The greater part of the diaphysis shows no changes but the contour of the upper and lower end has become irregular. In the central part of the upper epiphysis the penetration of the X ray is diffusely increased. The upper epiphyseal line showed distinctly but the lower epiphyseal line did not. Ossification had progressed (Fig. 9) in a relatively large region of the lower end of the diaphysis.

End of the sixth week. In the lower end of the diaphysis the proliferation of the bone substance had progressed well but otherwise the diaphysis showed neither changes nor an increase in length. The penetration of the X ray through the central part of the upper epiphysis had increased very remarkably. The lower epiphysis showed an enlargement. The upper epiphyseal line was distinct but the lower epiphyseal line was not. The surface of the ulna was dense where it touched the upper end of the transplant (Fig. 10).

End of the ninth week. No remarkable changes were present in the diaphysis. The penetration of the X ray in the central part of the upper end of the diaphysis had increased more and more but the whole diaphysis had enlarged. The upper epiphyseal line was distinct but the lower epiphyseal line

was not. The transplant shows an increase in length. The ulnar shadow has increased (Fig. 11).

Death of the experimental animal occurred 60 days after the transplantation. The weight at this time being 760 grams.

**Macroscopical appearance of the transplant.** The transplanted bone had grown in very well. Its surface as smooth and on vertical section its entire appearance as normal so that every component of the bone could be distinguished. Thus the proximal articular substance etc. could serve their habitual function. The surface of the proximal epiphysis had become irregular. The upper epiphysis had thinned out its outer increasing in thickness generally. Other than that the proximal epiphysis had the normal shape. The epiphysis could not be distinguished as the epiphysis had been indistinct. By the epiphysis in an irregular position the large end replaced the small upper end of the diaphysis. This produced a gap between the end of the transplant and the proximal bone. However this was occupied by the fibrous cartilage which had ossified in areas. The length of the transplant had increased. The increase in thickness as ascribed to the lower end of the transplant. This area showed a remarkable proliferation of the cartilage cells and ossification.

**Microscopical appearance of the transplant.** The greater part of the contents of the upper epiphysis consisted of living articular substance but scattered throughout were cells which did not take the nuclear stain. The periphery and the distal opposite the epiphysal line consisted of cartilage but the upper surface became more osseous etc. In the cartilage no necrotic areas were seen. The surface covered with fibrous tissue. The entire diaphysis consisted of living bone tissue. But the bone lamellae are thick and dense and in consequence the interlamellar spaces are small and contain few cells. The lower epiphysis consisted of osseous tissue and cartilage, these two tissues were intermixed. The ossification took place in the cartilage and on osseous tissue. The contents of the interlamellar spaces are just the same as that in the normal bone. Nowhere as dead tissue found. The lower epiphysis as covered by a relatively thick connective tissue. While the upper epiphysal line remains a living zone of the cartilage it has lost the usual structure which was altered by very irregular arrangement of the cartilage cells. While we could not discern the lower epiphysal line either by the X-ray or by macroscopical examination the microscopical section showed the characteristics of the epiphysal line to be preserved. In this region cartilage and bone cells lay close to each other there was no boundary line which Sumita maintained was an indication of the cessation of growth of enchondral bone. This suggests that this part may grow in length. The larger part of the epiphysal line has lost its characteristic structure and is replaced by fibrous tissue.

To sum up this case the operative wound healed primarily and the transplanted bone grew in very well. While the growth in length of the forepart of the front leg on the side operated on had ceased the thickness of this leg increased. In spite of the excessive motion in the wrist joint and the limitation of the rotation of the forepart of the leg on the side operated on the animal used this leg very actively. The X-ray examination indicated that some parts of the bone substance had disappeared but these areas were occupied by irregularly proliferated cartilage. In the diaphysis no bony defects were found. There was a remarkable proliferation of cartilage and its ossification to fill the defect at the distal end resulting from the inversion of the radius which replaced the large end of this bone with the small end. Vertical section of the transplant presented the normal long bone characteristics. In the central part of the upper epiphysis was found that a small number of the bone cells had lost their nuclear stain. Elsewhere the transplant microscopically consisted of living bone and cartilage.

**EXPERIMENT 8.** Replantation of the right radius without periosteum examined 65 days after transplantation in a dog two months old weight 850 grams.

By the same operative method as in the former cases the right radius was removed and then transplanted in an upright position after stripping off the entire periosteum. The length of the transplant at the time of the operation was 7.5 centimeters. The operative wound healed primarily. At the death of the animal the forepart of the front leg on the side operated on was shorter by two centimeters but was of the same thickness as its fellow of the opposite side. The flexion and extension of the right cubital joint as normal but the rotation of the forepart of this leg was impossible. The wrist joint when the dog walked limpingly had been bent to a right angle touching the ground with the entire part below this point. But the animal had used this leg very actively. Death of the animal 65 days after transplantation. The last weight was 0.430 grams.

**Examination by the X-ray.** The contour of the upper and lower end of the diaphysis is irregular but the greater part of its middle is smooth and the entire diaphysis has increased in width with the enlargement marked especially in the lower end. In the middle part of the upper epiphysis the penetration of the X-ray has increased very remarkably so that the upper epiphysis is divided into two regions. The transplant has increased in length very slightly. The lower epiphysis showed no great changes and its enlargement is not so marked. The ulna showed a slight depression opposite the upper end of the transplant (Fig. 3).

End of the sixth week. The middle and lower end of the diaphysis showed no changes but in the upper end there was a semicircular area with an increased penetration of the X-ray. The diaphysis had

increased somewhat in thickness. At the upper epiphysis the areas which formerly seemed divided had united leaving a central perforation. The entire upper epiphysis had enlarged. The lower epiphysis was greatly enlarged. The upper and lower epiphyseal lines both of which had spread have again become narrow. A proliferation of the bone substance in the tissue surrounding the lower epiphyseal line was seen. The depth of the ulna had increased thereby forming a new hollow for a joint (Fig. 14).

Beginning of the ninth week. No remarkable changes at the upper and the middle part of the diaphysis were seen. Its lower end has enlarged a little. The area which had seemed as if perforated has become smaller by the progression of the ossification. The proliferation of the bone tissue has progressed markedly (Fig. 15).

Macroscopical appearance of the transplant. The transplanted bone has grown in very well. Its surface is smooth throughout. On vertical section it appears normal so that every component can be distinguished: the periosteum, cortex, marrow, substance etc. conserved their characteristics. In the middle of the upper epiphysis the bone substance has disappeared and has been replaced by connective tissue. The lower end of the transplant showed a remarkable growth of connective tissue and occupied a great defect between the lower end of the transplant and the carpal bones produced by the replantation in an inverted position.

Microscopical appearance of the transplant. I made microscopical preparations from the whole vertical section of the transplant. The upper epiphysis showed a very irregular surface and the ossified areas were divided by cartilage like septa. We found a tissue resembling connective tissue entering at the middle of the surface. The upper epiphysis was covered with a relatively thick connective tissue, and parts of it lying directly under this cover had been ossified to a great extent while other areas consisted of cartilage. In the ossified areas the cells in the interlamellar spaces were not dead as were those in the marrow of the ordinary bone. At the surface of the transplant in the diaphysis we found periosteum which developed as well as the normal periosteum. At the upper and lower epiphysis and in the cortex a living bone remained but the cells in the marrow had lost their staining power. There were bone cells the nuclei of which stained weakly but by closer observation we noted that in most of them the cell bodies were shrunken and had lost their nuclear characteristics.

In the interlamellar spaces bone cells were found while deeper here and there giant cells were present. Nowhere in the pre-existing bone was there development of cartilage. The greater part of the tissue developed in the region of the lower epiphyseal line consisted of cartilage and but a small part of that ossified. In the ossified part the normal marrow cells developed. Dead tissue is nowhere to be found. A trace only of the upper epiphyseal line remained. This was no more than a small area in

the center of the upper end of this diaphysis that remained as real cartilage. This is very curved and its breadth varies greatly in its different parts. A tissue conserving the normal construction of the epiphyseal line was found (Fig. 16). In this region there was no boundary zone: the cartilage cells lay close to the marrow cells. At one portion of the diaphysis near this area ossification had progressed. In spite of the active proliferation in parts of the epiphyseal line the direction phenomenon was lost and the arrangement of cells became very irregular (Fig. 17). As above described cartilage tissue in great quantity has enveloped the region of the lower epiphysis but the original epiphyseal line is lost as no tissues conserving the construction of the epiphyseal line remained.

To sum up in this case the transplanted bone had grown in very well. An increase in the length of the forepart of the front leg on the side operated on had taken place though this growth had been obstructed. This part of the foreleg had enlarged as well as its fellow of the opposite side. The rotation power of the forepart of the leg was lost and the fixation of the cubital joint was impossible yet the animal used this leg very well. At first under the X-ray examination we found an increase of penetration of the X-ray in the small part of the upper epiphysis and in the upper and lower ends of the diaphysis but after the fourth week an enlargement of the transplant began especially at the site of the defect between the lower end of the transplant and the carpal bones. Here we found a new formation of ossifying cartilage in great quantity.

The microscopical examination shows that the transplant consisted of living cartilage and bone except that the marrow presented changes in the staining power of the nucleoli in the middle part of the diaphysis. The cells of the upper and lower epiphyseal line were proliferated though most of them lost their characteristics. There is a portion of the epiphyseal line which conserved its characteristic histological construction.

All my experiments were with young growing dogs only. There was neither heterotransplantation nor transplantation of dead bones therefore my experiments do not involve the entire question concerning bone transplantation and are only a part of the transplantation problem. However I believe that I could have secured experimental material for the investigation of the changes occurring between the period of transplantation and the complete regeneration of the bone. The question arises as to whether the above described transplants would have degenerated and how they would compare with transplants treated by other operative methods.



Whether transplanted bone can be substituted after it has once lost its ability to live experiments performed heretofore point out that some areas of the transplant die after the transplantation while others for example the periosteum live.

And no doubt the results of my experiments above described show that the periosteum can live as it has shown not only the living appearance throughout every period after the transplantation but also a proliferation of the bone. The epiphyseal line and the epiphyseal cartilage also have shown life after transplantation and it is here that we find proliferation although this proliferation was irregular and only slightly active we were able to confirm a definite though slight increase in the length of the transplant. In every case ossification occurred especially in the epiphyses.

In respect to the other living elements i.e. the bone cell and marrow cells we can affirm that most of the bone cells lost their nuclear stain within 65 days after the transplantation in the experiment extending over the longest period. This staining power was either entirely lost or conserved to a weak degree.

The marrow cells lost their nuclear stain in all of my experiments. But I should like to call attention to the fact that the bone cells and the marrow cells of the transplant in my experiments are in a most unfavorable condition to get their nourishment because I transplanted the bone with a completely closed medulla as contrasted to the open method which authors have advocated as being necessary for bone transplantation.

No doubt my experiments cannot be final for the fate of all transplants many of which are treated in other ways than those in my method.

The bone cells and marrow cells as they have been described clearly in the experiment reduce their nuclear stain or disappear but they are soon replaced by another component with a stronger living power therefore the transplant on the whole can live and does not undergo remarkable changes in its form. For this reason I cannot agree with the extreme opinion that all transplants cannot live.

As a result of my experiment I will discuss

the changes in every component of the bone after the transplantation as follows.

*The periosteum.* Authors are agreed that periosteum transplanted with the bone does not die and has an important bearing in the new bone building even Barth who had advocated that the periosteum transplanted with bone dies and that regeneration takes place from the neighboring periosteum revoked his former view and confirmed the living and producing ability of the periosteum.

But Barchizew and Peterow (5) said. The transplanted bone without periosteum can regenerate completely. According to the opinion of Mayer and Wehner in spite of the macroscopically complete stripping of the periosteum the osteoblasts of the cambium layer can be transplanted. In many experiments there are two (the second and eighth) in which the entire periosteum was completely stripped macroscopically in all other cases the bone was transplanted with its complete periosteum. At no period of our experiments has the periosteum transplanted with the bone showed any marked degeneration and on the whole was very well preserved. Moreover we found an increase of cells in this layer and we found that these cells enter into the deeper layer of the transplant. In the subperiosteal layer i.e. the most outside layer of the cortex cells have been usually very well preserved.

In the second experiment on the transplant without periosteum taken out in 12 days the layer where the periosteum had been consisted of connective tissue rich in cells in the subperiosteal layer. There was no cell degeneration. As the first step in the new bone building process progressed from the periphery into depths there were blood vessels and cells entering the interlamellar spaces. In the eighth experiment the transplant taken out 65 days after transplantation without periosteum the proper periosteal layer had increased in areas to a complete periosteum which had a tendency to unite and to cover the bone. In this case the outer layer of the transplant is replaced by new tissue while in the medulla the marrow had necrosed. But in the cases of the two dogs of the same litter in which transplantation

was done with the periosteum intact the transplants after 42 and 60 days had no dead tissue and further the microscopical examination shows active regeneration. In the epenosteal transplant of the eighth experiment removed 65 days after transplantation the growth and regeneration of the bone is slight and we find a moderately large part in the middle part of the diaphysis poorly nourished. On the basis of my experiments I can establish the incontestable fact that periosteum transplanted with the bone can live a long time and actively form new bone. In my opinion the fact that transplanted bone without its periosteum can regenerate may be due to the cells of the cambium layer as Mayer and Wehner formerly advocated for (1) the cells in the subperiosteal layer in all my preparations have been well preserved and (2) the proliferation of the periosteum in the bed of the transplantation raises no question about the source of regeneration because I took out the radius with its entire periosteum and replanted it after having stripped it outside of the body.

For comparison between transplants with their periosteum and those without it my experiments are not quite extensive enough to establish which method is the better. But I may be allowed to say that the regeneration of the bone, in case of the transplants without periosteum, is delayed and therefore that the periosteum is very necessary to aid growth and regeneration of the transplant.

*The bone cells and the bone substance.* The great majority of authors have held the opinion that the transplanted bone cells die but Bonome (7) denied this and insisted that they proliferate. The fact has been shown that the bone cells can live a long time after the transplantation for example 90 days (Tomata) and 100 days (Barchizew Peterow) Mayer and Wehner said

*Die Anschauung, dass der transplantierte Knochen voll ständig der Necrose verfallen muss, dahin eingeschränkt werden, dass wohl die Mehr-  
heit der Knochenzellen absterben, ein Teil sich aber nur Vascularisierung des Transplantates erhalten kann. Jedoch geht niemals von diesen Knochenzellen Knochenneubildung aus.*

While in my preparations most of the bone cells have lost their nuclear staining power within certain days after the transplantation

there were cells which retained this for a long time (65 days). But as a rule they stained weakly and their nuclei were shrunken taking on an irregular form. I have never found signs of proliferation of these cells.

With respect to the bone substance in the third experiment I could find Haver's canals gradually enlarged by the entrance of the giant cells and replaced by newly formed tissue as other authors have noted yet in the eighth experiment the bone lamellæ remained largely without change in quantity or arrangement.

*Marrow.* Axhausen and Frangenheim thought that the transplantation of the marrow was justifiable but that conditions must be favorable. In my experiments the marrow cells have always lost the nuclear staining power. Because I transplanted an entire bone in a completely closed condition there was no way for nourishment to enter into the medulla therefore I have no basis for argument concerning this question. But I can affirm that the marrow cells which have once lost their staining power can be replaced by some other bone component having powerful regenerative ability.

*Joint cartilage and epiphyseal line.* Obata's experiment showed that a part of the transplanted joint cartilage especially that of the periphery can live while the other parts especially the central areas die. The living cartilage has regenerative ability.

In all my experiments the bone cells and marrow cells in the central ossified part of the epiphysis have lost their nuclear staining power but most of the cartilage in the periphery lives and grows. Sometimes after a long period the contour of the epiphysis becomes irregular and at these irregular areas connective tissue enters. But the proliferation of the cartilage cells the ossification of the matrix and an enlargement of the epiphysis always occur.

Experiments concerning the epiphyseal line are increasing year by year and these on the whole confirm the opinion that the epiphyseal line can be transplanted but not without injury to its original character. Helfferich (15) Borst Rehn and Wakabayashi (25) Galerazzi (13) Obata (22) Heller (14)

Erdenlen (18) Arthausen (4) Zoppi (30) As the rule that part of the transplanted epiphyseal line lying under the perichondrium lives while that in the central areas die

My experiments show that the epiphyseal line is one of the resistant tissues like periosteum and joint cartilage because its cells do not die until 10 days after transplantation. In the seventh experiment after 60 days a part of the lower epiphyseal line and in the eighth experiment after 65 days a part of the upper epiphyseal line had conserved their characteristic construction. There was no indication of the cessation of the endochondral bone growth except the fifth in which after 10 days all cells of the epiphyseal line had died. Besides we find parts with living and proliferating cells but their arrangement has become very irregular having lost the characteristics of an epiphyseal line. In this period the epiphyseal line does not remain a straight line but shows a remarkable bending.

In spite of the living cells in the epiphyseal line there is a struggle between three powers. A small part conserves the direction phenomenon and enforces a growth in the long axis of the bone another part whose characteristic construction has been lost assumes an irregular arrangement of cells which expand the epiphysis while the connective tissue replacing the dead cells has a tendency to contract. Therefore there is good reason for the failure of growth in the long axis of transplanted bone. My experiment confirms Arthausen's opinion. Der Epiphysenknorpel ist im histologischen Sinne transplantationsfähig doch nur in einem fuer die praktische Anwendung unzureichenden Umfange.

From the above experiments the auto transplantation of the half joint will succeed if there is any indication of growth in the transplant.

*Tissues from which transplanted bone regenerates.* As sources of bone regeneration those tissues have been mentioned which have a life so resistant that they can protect the new growth of bone. Periosteum marrow bone cells connective tissue cells of the bed of the transplant and endosteum and marrow cells of the recipient have been mentioned.

In my experiments I transplanted in an inverted position an entire radius either with or without its periosteum after removing it completely from the body. Therefore I cannot discuss this question because both the connective tissue in the bed of the transplant and the periosteum and the marrow of the recipient are out of the question as the sources of the bone regeneration. No doubt the fact that in my experiments the periosteum and the subperiosteal tissue do not die but instead increase in number in contrast to the bone cells and marrow cells shows that at least these structures are sources necessary for the protection of the life of the transplant. Besides the epiphyseal line the epiphyseal cartilage and the perichondrium take part in protecting the life of the transplant. One must take the greatest care not to injure the periosteum and the subperiosteal tissue as they show that they are alive in every period after the transplantation and that there is a formation of bone beneath them which is almost equal to that of the undisturbed normal.

*Growth of the transplanted bone.* Concerning the growth of the transplanted bone Ollier said:

L'accroissement des épiphyses fait le 1<sup>er</sup> fait commun à l'os normal et à l'os greffé. Les propriétés du périoste préexistent à l'os et assurent son développement. Le périoste de l'os greffé se développe à l'os et assure son développement.

The increase in the thickness of the transplanted bone is distinctly confirmed by the X ray examination especially the new growth of cartilage and its ossification that have taken place in those parts exposed to the greatest physiological excitement. This is illustrated by the changes taking place at the defect made between the under end of the transplant and the carpal bones by the inversion of the transplant.

#### CONCLUSION

1. The bone with its periosteum if it is transplanted in the same body under favorable conditions continues to live.
2. While among the various components of the transplanted bone the bone cells and the marrow have changed their ability to take

the nuclear stain at the end of the third week after the transplantation the periosteum the subperiosteal tissue the epiphyseal cartilage and the epiphyseal line give distinct evidences of life

3 Among the various components of the transplanted bone the periosteum and the subperiosteal tissue have not only lived throughout every period of the examination but have executed an active formation of new bone

4 Most of the epiphyseal cartilage and epiphyseal line have lived throughout every examination, as has the periosteum and they have, moreover, carried on an active proliferation and ossification. Yet they are irregular losing their physiological relationships

5 The bone cells and the marrow have lost or changed the staining power of the nucleus in a short time after the transplantation but the physiological or nearly physiological appearance returns after a certain time, being replaced by the resistant components of the transplants

6 The apenosteal transplant grows and regenerates by the proliferation of cells in the subperiosteal layer. But in such a case the new growth of bone is not so active as in the transplants with periosteum. The apenosteal transplant acquires a new periosteum

7 The aim of the bone transplantation can be reached without the periosteum and marrow of the recipient. As to the continued life of the transplanted bone however I cannot give a definite opinion at this time

8 Transplanted bone grows the increase in thickness is marked although the length increases but little even when transplanted with the epiphyseal line.

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## CONGENITAL GENU RECURVATUM

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**SYNONYMS** Congenital hyperextension (Sayre) *Luxation du tibia en avant* (Fr) Congenital dislocation of the knee Congenital anterior subluxation

**Definition** Congenital genu recurvatum is a malformation of the knee present at birth and characterized by a hyperextension of the leg on the thigh a deformity ranging in degree from a simple exaggeration of the normal extension to a condition represented by subluxation or actual anterior luxation of the tibia on the femur.

**Historical** In the group of congenital malformations of the limbs genu recurvatum is probably the least frequent yet in recent years it has proved to be a source of much study and controversy. Before the year 1880 the literature contained but few reports relating to this condition. Bard (7) Kleeberg (55) Chatelain (19) Albert (1) Wutzer (12) and a few others had published isolated reports but it was Guenot (38) who in 1880 first called attention to genu recurvatum in a communication which he read before the *Société de Chirurgie* reporting two cases. The following year Hibon (45) his pupil used the cases of Guenot and of Perier (82) as the subject for his thesis. With the recognition of this condition many observations began to appear in the literature and even in 1888 Mueller (75) succeeded in collecting 25 cases. Following this article there appeared that of Dechy (27) *Thèse de Lille* 1890 Phecas (84) *Revue d'orthopédie* 1891 and Spoerni (109) *Thèse de Zurich* in 1891. In 1897 Potel (87) reported 78 collected cases and in 1900 Drehmann (32) was able to accumulate in the literature and report 127 observations. Since then with the added cases of many observers, among whom may be mentioned Kärmisson (54) Delanglade (28) Derocque (30) Florion (34) Magnus (71) Reiner (91) Rechman (89) Mouchet (74) and Mutel (77) there are at least 165 recorded cases.

## RELATIVE FREQUENCY AND SEX

Although a relatively rare deformity genu recurvatum is the most frequent of the congenital deformities of the knee. As compared with congenital dislocations of the hip Drehmann in his investigations found the relative frequency to be 5 cases of genu recurvatum to 150 luxations of the hip. The frequency however is probably greater than this as in late years the number of reported cases in the literature has been greatly augmented. Kroenlein (62) one of the early contributors to this subject cited the relative frequency as 1 case of genu recurvatum to 90 luxations of the hip. The records of the Outpatient Department of the Children's Hospital show the relative frequency as 2 cases of genu recurvatum to 197 cases of congenital hips. As in congenital hips but to a less marked degree genu recurvatum is more frequent in females the relation being about 3 to 1 (Potel) while club foot on the contrary is more frequent in the male. As to the relative involvement of one or both knees it may be said that the malformation occurs slightly more frequently as a unilateral than as a bilateral condition. In the 72 cases cited by Potel the frequency was 35 bilateral and 37 unilateral while in the statistics of Drehmann compiled from 177 cases the relative occurrence was 49 bilateral and 54 unilateral. If unilateral the malformation occurs more frequently on the left side.

## ACCOMPANYING MALFORMATIONS AND DEFORMITIES

It is not infrequent to have genu recurvatum associated with other congenital anomalies a combination which occurs so frequently that one might proclaim it to be the rule rather than the exception. The most frequent of these malformations are the talipes which are nearly always double and which may exist in any of the forms. Potel noted the presence of club foot 20 times in 78 cases of

genu recurvatum. The co existence of congenital luxation of the hip is also very frequent and many cases reported in the literature possess this combination. Spoern (109) Ridlon (94) Drehmann Cordier (23) Tindon (114) in 120 cases of congenital dislocation of the knee found the hips dislocated 20 times. The knee itself in addition to its hyperextension may be in a condition of varum or valgum the latter condition being more prevalent (Sayre 100 Joachimstal 50 Curtillet and Lombard 25 Albert Ridlon). An internal and external rotation of the leg has also been observed in several cases (Derocque Drehmann et al). Other combined congenital anomalies are spina bifida Kroenlein Richards (92) Ridlon hydrocephalus Delanglade mongolism Cordier cryptorchism Schoenfeld (102) angiomata Gusli cited by Kirmisson facial paralysis Beely (9) imperforate anus Tarnier (110).

Curtillet and Lombard reported a case where in addition to a genu recurvatum there was an anterior luxation of the ulna and radius on the humerus. Hofmokl's (48) case showed a hyperextension of one limb and acute flexion of the other. Permanent flexion of the thighs on the abdomen has been noted in several cases (Delanglade Florion Shatlock, 104).

#### SYMPTOMATOLOGY

Genu recurvatum is primarily characterized by a hyperextension of the leg on the thigh the degree of deformity depending to a great extent on the amount and the flexion of this hyperextension. In the mild cases the leg thus hyperextended forms with the thigh an angle of about 170 degrees and flexion although limited, can usually be accomplished considerably past 180 degrees. In the more severe cases, the leg is often hyperextended to form an extremely acute angle with the thigh and although it may be possible to further hyperextend the leg flexion is either impossible or present to only a slight degree. Any muscular effort on the part of the child tends to further hyperextend the leg the infant apparently using the flexors of his legs as extensors. In the case reported by Wutzer the hyperextension was so marked that the

anterior surface of the tibia could be brought in contact with the anterior surface of the femur. During active movements of the patient, the toes may strike the face shoulders chest abdomen or thighs depending on the degree of hyperextension of the knees. In Hilton's (47) case, the infant usually slept with his toes in his mouth. Examination of the knee itself reveals a most characteristic condition. Though they may be in an abnormal apposition to each other the adjoining extremities of the tibia and femur are normal in size and contour. There are no evidences of atrophy. Anteriorly may be seen typical cutaneous folds usually 3 or 4 in number due to the condition of hyperextension. These folds are true, articular sulci such as are seen on flexion surfaces of joints and are not merely superficial cutaneous markings. At birth they are filled with vernix caseosa and in older children with sebaceous material. The skin is abundant on the anterior surface and one may often feel fat pads which make palpation of the head of the tibia or the patella extremely difficult or impossible. One may in some cases feel anteriorly a prominence of the condyles of the tibia an observation emphasized by Drehmann as clinical evidence of a luxation. Clinically the patella may be barely palpable or absent. Hartigan (43) Jolicoeur (51), H L Taylor (111) Barwell (8). If present, it is usually situated high, being in relation to the anterior surface of the lower end of the femur and apparently taking no part in the articulation. The clinical observations in regard to the patella however are wholly unreliable as in some cases where it had been reported absent its presence was determined later. In the case reported by Jung (52) a patella thought to be absent through negative clinical and X ray findings was found at autopsy.

Posteriorly the skin loses its normal redundancy and is stretched so to speak over the prominent condyles of the femur. The intercondylar fossa is readily palpable, and one may feel the pulsation of the popliteal vessels pressure upon which by reason of the hyperextension has produced cyanosis and edema in the lower limbs. There is never

any effusion in the knee or evidences of paralysis or atrophies. The joint capsule may be uniformly lax (Wolff 120 Tarnier) but if present there is usually associated a laxity of other joints. Lateral mobility is rare but was present in the cases of Kroenlein Myers (78) and that of Curtillet and Lombard. Genu varum or valgum may be an associated deformity with the hyperextension. (Albert Kroenlein Meyer Sayre Bajardi 4 Joachimstal). In Sayre's case the leg was abducted 45 degrees on the thigh. There frequently occurs with genu recurvatum a flexion contraction of the hip as in Delanglade's case a condition which may tend to inhibit motion at that point. The infant if left to himself never flexes the limb but any active movement is expressed in further hyperextension. One may passively increase the hyperextension to a limited degree without causing pain to the patient but if an attempt is made to flex the knee the child usually cries out and a point is soon reached where further flexion is prevented by a resistance which does not disappear even under anesthesia. Sudden relaxation of a flexed limb causes it to spring back to its vicious position with an abruptness most striking the *plénon éné du resort* of the French writers. This maneuver is extremely characteristic and apparently is due to the tension of the quadriceps and lateral ligaments.

#### PATHOLOGICAL ANATOMY

Although the clinical condition of genu recurvatum is well recognized today the pathological interpretation of the condition is still a subject of great controversy. There are in the literature about twenty autopsies and the pathological finding at some ten operations. Leo Mayer (73) in his comprehensive review of the pathology of this condition added to the literature a detailed description of an old specimen discovered in the Munich Pathological Institute.

Autopsies have shown very little deformity of the joint the articular extremities of the femur and tibia are practically always normally developed though slight degrees of atrophy has been observed in some cases. In Delanglade's case the posterior portions

of the femoral condyles were undeveloped to the extent that they formed no projection beyond the posterior plane of the femoral diaphysis. The condylar surfaces are usually parallel longer and narrower than normal. Differences in the development of the condyles have been noticed in those cases presenting degrees of genu valgum and varum. In occasional cases as in those of Barth (6) and Delanglade there has been observed an anteverted position of the epiphyseal end of the femur. No actual epiphyseal separation has ever been noted. The patella is often developmentally retarded or atrophied and occasionally absent. In the cases of Hofman and von Sclis (98) cited by Mayer it was completely absent. If present it usually does not enter into the articulation but is situated above its normal position resting on the anterior surface of the lower end of the femoral shaft from which it may be separated by a bed of fat or cellular tissue (Albert Delanglade Jung Mouchet Mayer). In Shields (105) case the patella was firmly adherent to the femur. The superior cul de sac is often absent. The tibia articulates with the anterior superior portion of the femoral condyles that is to say with the portion normally occupied by the patella and there is usually a faceted depression for its reception. The uncovered posterior part of the articular surface of the femoral condyles may be atrophied (Jung Magnus) or partially devoid of cartilage (Mouchet). The articulating and non articulating portions may be separated by a cartilaginous ridge as found in Delanglade's autopsy. The semilunar cartilages are usually normal in size. Cases have been reported where they have been small (Magnus) or partially absent (internal cartilage in Max Reiner's case).

The crucial ligaments are as a rule lengthened and at times atrophied (Barth Mayer). The capsular ligament is stretched and thickened posteriorly contracted anteriorly the latter to such a degree in some cases as to prevent reduction (Shields Shattock). A condition of apparent capsular atony has been described by some authors (Wolff Friedleben 35). The quadriceps muscle in practically all cases has been found to be

contracted and is largely responsible for the maintenance of the deformity (Owen 81 Guenn, 39, Roberts, 95, Mayer) In Renner's case a most unusual laxity of the quadriceps was noted. In several reported autopsies Tarnier Delanglade Mouchet, Magnus Plagemann (85) and Mayer a peculiar forward luxation of the biceps was noted the tendon passing in front of the external condyle in such a manner that it become an extensor of the knee tending in action to exaggerate the deformity (see Fig 1) In Delanglade's case the internal hamstrings were also luxated forward

Mayer emphasized the importance of the occasional abnormal origin of the gastrocnemius in the production of the deformity of genu recurvatum. In Jung's case the heads were displaced outwardly in Mayer's case downwardly conditions which freed the posterior condyles from the normal forward pressure of the muscle thus favoring the occurrence of a genu recurvatum

#### NATURE

With the pathology of genu recurvatum as the basis many theories as to the true nature of the condition have been suggested. Is the condition of genu recurvatum or congenital hyperextension of the knee primarily due to accommodative contractures and changes at the joint following its retention in a prolonged vicious position or is it due to an actual anterior subluxation or luxation of the tibia on the femur?

As early as 1880 Lannelongue (66) proposed that the condition of genu recurvatum was a simple hyperextension of the leg on the thigh without any element of luxation. This view was upheld later by Potel who after a most careful resume and study of 78 cases concluded 'Genu recurvatum is neither a luxation nor an epiphyseal separation. It is a hyperextension of the leg on the thigh produced by a contracture of the triceps (quadriceps) during fetal life, the period in which the triceps is involved varies from the third to the fifth month

Guemot, Hibon Phocas (84) Redurd (90) and others maintained and attempted to prove experimentally that the condition

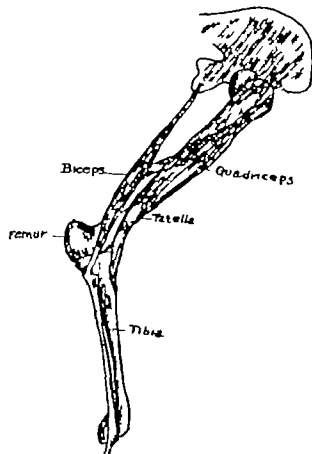


Fig 1 Dislocation of the biceps forward in congenital dislocation of the knee so that it has become an extensor of the leg (After Muskat)

of genu recurvatum was due to a femoral epiphyseal separation with subsequent mal union giving rise to the anteversion observed in some cases. But in the reported autopsies and in the careful examination of many radiograms no evidences of any actual diaphyseal separation has ever been noted. The occurrence of anteversion of the lower end of the femur in genu recurvatum may certainly contribute to the deformity but its great infrequency warrants its consideration only as an accessory element in this condition. In one of Delanglade's cases it was present while in the other it was absent. In a case reported by Renner there was on the contrary a retroversion of the lower end of the femur. The actual cause of this anteversion may be due to the protracted muscle pull maintained by Potel as the cause of the deformity in genu recurvatum.

Drehmann in 1900 in his comprehensive communication reviewing 127 collected cases including 5 personal observations was led to



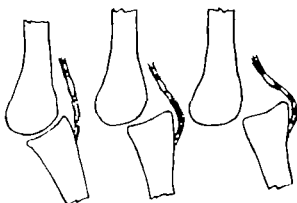


Fig. The development of untreated genu recurvatum into complete dislocation. (After Drehmann.)

conclude that there was no actual difference between genu recurvatum and anterior luxation of the tibia. That the name congenital luxation was much more accurate and that the term genu recurvatum should be reserved for those cases of hyperextension where normal flexion was present and where the femoral condyles were not prominent posteriorly. He discussed 100 cases of congenital anterior dislocation. Several cases he contended were genu recurvatum at birth or in the first months developing later through weight bearing into anterior luxation as a course of development which has its analogy in the development of many cases of congenital hips (see Fig. 2).

Many of the more recent contributors to the literature have confirmed many of Drehmann's views. The autopsies of both Delanglade and Mouchet revealed a definite condition of forward luxation of the tibia. In the cases where operative interference was undertaken the forward position of the tibia was also noted (Curtillet and Lombard Ruerer Wolff Magnus). The great value of the X-ray in determining the presence and the degree of this condition is emphasized by Florion. Karmisson on the other hand maintains that the condition of genu recurvatum is not a luxation but is the consequence of a vicious attitude prolonged for a great while without true luxation. In luxation he continues one sees a partial or total separation of the articular surfaces but one never sees a reciprocal depression on one bone for

the reception of the other in its abnormal position. This condition cannot be produced by a sudden displacement as in luxation but can be due only to an abnormal pressure produced by a prolonged vicious attitude a pressure which results in the anteversion of the lower end of the femur observed in some cases. One may compare he adds genu recurvatum to congenital club foot (equino varus). In this condition there is partial abandoning of the tibia fibula mortise by the isthmus with distortion of the head and neck of the latter resulting in the loss of its normal relation to the os calcis and scaphoid. There is here as in genu recurvatum an osseous malposition and deformity due to a prolonged vicious attitude. We do not arrange club foot in a group of congenital luxations. Karmisson states. We do not seek to obtain at a single time a reduction of the deformity or to return at the first onset the articular surfaces to their normal relation. Mute! also emphasized this point in the treatment of a patient whom he cured by progressive corrections. Reduction in luxation he maintains is accomplished with a sudden noise or click felt by the finger and the reduction retains the limb in the corrected position. In genu recurvatum the reduction is usually rapid without pain but will recur immediately if not retained in the corrected position.

To the writer it seems apparent that many of the contributors in attempting to seek a generic term suitable for the designation of this malformation have been rather influenced by the case or cases under their actual observation. It has been conclusively demonstrated that this condition shown clinically as a hyperextension of the leg on the thigh may represent anatomically any degree of deformity ranging from a simple hyperextension without any element of displacement through all degrees of subluxation to an actual anterior luxation of the tibia on the femur that a case either may pass progressively from one degree of deformity to the next or may assume permanently the characteristics of any single degree of this malformation. To attempt to designate the general condition by an expression descriptive of but one type or degree as for example

anterior subluxation or anterior luxation is therefore obviously wrong. The term genu recurvatum is the only clinical expression that should be used generically to designate a malformation represented by so many degrees of deformity and the employment of other more specific terms should be used only to qualify or describe the type of genu recurvatum under discussion.

Congenital torticollis a term which in its application may be considered comparable to genu recurvatum can be a deformity resulting from any one of several anatomical variations. Because of this fact one is not justified in discarding the expression torticollis as a generic term and substituting in its place a terminology descriptive of its various types.

Leo Mayer suggests and employs the expression congenital anterior subluxation as being a more precise term in designating this deformity. He maintains that genu recurvatum is too broad a title and indicates the symptom not only associated with anterior subluxation but occasionally with posterior congenital subluxation and frequently with other deformities about the knees as in rachitis bowing of the tibia and improperly reduced fractures.

With the exception of the congenital posterior subluxation, the other types suggested are conditions of acquired deformity all of which should and can be readily differentiated from the congenital form of genu recurvatum.

#### PATHOGENESIS

The actual intra uterine and prenatal conditions contributing to the deformity of genu recurvatum are as for other congenital malformations as yet undetermined. Heredity plays no part in its occurrence, although there are in the literature a few cases where congenital deformities existed in other members of the family. Ridlon reported two sisters one of whom possessed a bilateral genu recurvatum the other a bilateral genu recurvatum and a dislocated hip. In Baker's (5) case, the father, the aunt, and two uncles had club feet, the patient having a double genu recurvatum and club feet. Magnus reported a family of four children three of

whom had genu recurvatum. Injury or trauma to the mother during the prenatal period has been attributed as an etiological factor and in some cases may no doubt, have an accessory bearing on the condition. In Skelton's (107) case this trauma was thought to be produced by an unusual habit the mother had of carrying a child two years old astride her pregnant abdomen. Hydramnios an associated condition that has been observed many times (Blanc 13, Timmer 113, Wagner 117 and Chambrelent, 18) has been thought by some writers to be the causative agent. In Chambrelent's case the amount of fluid was nearly 4 liters. In the majority of cases normal deliveries with head presentation have been observed but breech deliveries have been not at all infrequent (Bouvier 15, Bertin, 10, Kroenlein Richards). Mueller observed a face presentation. The relative infrequency of all these conditions, however in cases of genu recurvatum strongly suggests that they were merely coincident and probably had no direct etiological bearing in the production of the deformity. The theory of germinal alteration as has been proposed for club feet by Bessel Hagen or for congenital luxation by Dollinger and others has been abandoned. Verneuil attributed the condition to a contraction of the extensors of the leg following a paralysis of the flexors but this theory is not compatible with the speedy recovery not infrequently observed in these cases. The theory of increased intra uterine pressure as a cause of the malformation is emphatically denied by Potel who attempts to prove that this pressure if present would have the tendency to reduce the deformity rather than increase it. He attributes the deformity to a primitive contracture of the quadriceps produced by an arrest of development occurring during the third to fifth month as indicated in the atrophy or absence of the patella a contraction produced by a prolonged muscle spasm of central origin after the theory of Broadhurst. For the majority of contributors this quadriceps shortening is due to secondary nutritive and physiological changes in the muscle following the condition of hyperextension. In Delan glade's case the muscle was pale and atrophic.

The theory of Wolff and Strohmeier that the condition is due to capsular atony is questionable. Capsular atony noted in a very few cases allows flexion of the knee as well as hyperextension and lateral mobility. But conditions in genu recurvatum. Karmisson has looked for a single cause to explain many of the associated congenital deformities. The extremities are held in front of the trunk during the normal development of the fetus and many factors such as intra-uterine or extra-uterine pressure, amniotic bands, oligohydramnios may retain them in an abnormal position. Under the influence of this prolonged vicious attitude the deformities of genu recurvatum, club feet and dislocated hips may occur owing to displaced or abnormal epiphyseal cartilage and deferred epiphyseal ossifications.

The most plausible theory is that suggested by Drehmann. At the period of differentiation of joints the knee is held extended, normal flexion being prevented by the catching of the foot on the chin in the axilla, shoulder or some other obstacle. The limb at this period is undergoing rapid growth, the muscles are undeveloped and though there may be an abundance of amniotic fluid flexion of the knee is impossible and the condition of hyperextension results. Simple hyperextension may first result and later a subluxation or true luxation. The other associated deformities as club feet, congenital hips etc. may occur with this condition. There can be no doubt that many of the infants at birth show an attitude strikingly suggestive of this theory. They are usually born with marked flexion of the thighs on the abdomen, leg hyperextended, a sort of jack-knife position. In Wehsarg's (118) case cited by Mayer, an intra-uterine examination just before delivery revealed this position. The actual cause of the retention of the limb in Kuestner's (65) case was a locking of the foot in the axilla. An absence of the chin due to the prolonged pressure of the sole of the foot on the face was observed in Shattock's case cited by Shields.

#### DIAGNOSIS

The clinical condition of congenital genu recurvatum is so striking that its diagnosis should offer very little difficulty. Its presence

at birth, the co-existence of other congenital deformities, the absence of stigmata of rickets, establishes its congenital nature beyond doubt. One must differentiate luxation deformities if the condition is one of this type from some forms of arthritis and paralysis of muscles. The congenital ante-flexion of the tibia described by Karmisson and by Jala-guier may produce the genu recurvatum but there is usually very little difficulty in differentiating the two conditions.

#### PROGNOSIS

The prognosis of genu recurvatum is good and under a careful and well regulated treatment the results obtained are usually most gratifying. The prognosis may depend on the early treatment of the patient but not necessarily so. In the case of Hilton mentioned by Potel, the child, 2 months of age, walked on its femoral condyles, the leg directed forward, the feet in the air, the soles of the feet faced directly upward. In the case of Reiner, the child had a genu recurvatum in which the leg were at right angles to the thighs, the patient on standing used the calves of the legs as one normally used the soles of his feet. By grasping his feet in his hands and alternately raising his limbs at the same time, swaying his body to the opposite side, the patient was able to walk. Both cases recovered under proper treatment.

Joachimstal reported the spontaneous cure of two cases and advised delay in interference.

#### TREATMENT

The therapy of genu recurvatum should be governed absolutely by the type under consideration and if one wishes to obtain the best results the method employed must be chosen only after a most careful clinical and radiological study of the case under observation. That this condition may present any single or several successive stages from a simple hyperextension of the knee without any element of luxation through the various degrees of subluxation to an actual luxation has been well demonstrated. Expectant treatment although successful in some cases (Joachimstal) is not to be advised for genu recurvatum any more than for club foot or

congenital dislocation of the hip and the best results may be promised in those cases where the earliest possible treatment is instituted.

In simple hyperextension and many of the milder forms of subluxation progressive flexion manipulation and massage followed by careful retention of the limbs in the improved position may be all that is necessary for a complete recovery. One must use great caution and govern himself by occasional radiological examinations as it has been shown in some cases that the supposed reduction may be only apparent while in other cases the corrective movements have actually increased the degree of subluxation.

In more severe types of subluxation and in luxations a maneuver similar to that employed in traumatic luxations may be used. Under anesthesia the limb is held in traction and an exaggeration of the tibial hyperextension maintained at the same time. Backward pressure is then exerted on the tibial head counter pressure on the femoral condyles and by a rapid movement of flexion the luxation may be reduced. The hamstring tendons which when traction is made on the limb prevent reduction of the tibial head by a button hole approximation similar to that observed in a dislocation of the thumb are relaxed in this maneuver. Care should be taken to prevent complications such as fracture of the femur (Drehmann) or separation of the epiphyses (Shields). Mayer suggests the possibility of using the Bradford congenital hip machine to accomplish reduction in these cases. Following reduction the joint should be held in flexion by plaster of Paris or some other form of splinting and massage and passive motion regularly instituted.

If reduction by these methods is unsuccessful open operative interference is indicated. The operations advised for the cure of this malformation consist chiefly in overcoming the obstacles to reduction either by division or by plastic methods. The quadriceps tendon is probably the most frequent obstacle though Drehmann maintains that the hindrances to reduction are mostly in the fixation of the tibia in its abnormal position and

the internally luxated flexor tendons. Owen obtained complete reduction by a simple division of the quadriceps tendon. Wolff in a case of complete luxation lengthened the tendon by a plastic tenotomy and in addition freed the tubercle and fastened it to a higher level with an ivory peg. Curtillet and Lombard in their cases followed somewhat the Wolff technique but stitched the tubercle to a higher level on the tibia. They advise the Wolff operation for obstinate cases but emphasize the great necessity for a prolonged postoperative immobilization of the limb. In some cases it has been found necessary to incise the capsule or the iliotibial band before reduction can be accomplished. Arthrodesis should only be thought of in the extremely grave cases or in cases that have completed their full growth. In Reiner's case a boy 8 years of age the tibial plateau was gouged to fit the femoral condyles. Active flexion to 70 degrees was possible in seven months.

#### CASE REPORT

E. St. L. age 13 months female. Family history. Parents are alive and well. One brother and one sister are living and well. No history of any congenital malformations either on maternal or paternal side of family. No history of any trauma or accident previous to the birth of the patient.

*Present history.* Was born spontaneously after a moderate labor in a frank breech presentation. There was noted no increase in the amount of amniotic fluid. Examination of the child immediately after delivery showed the thighs to be acutely flexed on the abdomen and the knees hyperextended to such a degree that the feet were brought in actual contact with head of the infant in a position described by the accoucheur as resembling the shape of a jack knife. The thighs could not be extended more than 30 degrees. Under progressive manipulation the attending physician was able to increase the extension of the thighs but as no improvement was made in the reduction of the deformity of the knees and as there seemed to be an increasing deformity of the feet it was recommended that the patient go to the Children's Hospital for treatment.

Examination at that time showed a healthy well nourished infant of 5 months. Physical examination was negative except for the condition already described. Both thighs were held flexed 110 degrees abducted 35 degrees. They could be brought to full extension but no hyperextension was possible. All other motion at the hips was normal. Both knees were held in hyperextension. On the right side flexion was possible only to a position repre-

sented by full normal extension on the left side the knee could be flexed to 3 degrees. If during an attempt to bring the limbs into normal position they were released suddenly they rebound to their vicious position (bilateral disorder) so characteristic of this condition could be clearly demonstrated.

The patellae could not be palpated. The right femur is in equino valgus the left in equino varus. Any voluntary muscular movement of the infant tended to exaggerate the deformity the thighs flexed, the feet striking face or shoulders. The habitus phenomenon had been frequently observed by the mother. Many X-rays of the knees were taken at this time and again later with a view to determining the exact relation of the articular surfaces of the bones entering into the formation of the joint. Figure 3 is lateral view of the right knee taken at this time. It will be noted that the hyperextension of the knee is due to an actual forward slipping or subluxation of the tibial epiphysis on that on the femur. Nearly the whole of the anterior half of the epiphyseal cartilage of the tibia which shows as a shallow around the osseous center projects anteriorly to that of the femur its articular surface of normal relation to that of the femoral condyles. As a result the posterior articulating surface of the femoral condyles is also free.

The bony like axial relation (bony axis) characteristic of displacement is all shown here. If the longitudinal axis of the femur is prolonged so as to meet that of the tibia in place of meeting to form an angle a figure somewhat resembling butterfly results. The anterior border of the femur is approximately in alignment with the posterior border of the tibia another indication of displacement. There is no evidence of any epiphyseal separation or displacement contributing to the deformity. The patella which may be seen as a thickening in the quadriceps tendon is situated higher than normally. It was not palpable clinically.

Under anesthesia the limbs were forcibly manipulated and a double plaster of Paris spica applied with the thighs fully extended the knees flexed to as great a degree as was possible to obtain. During the corrective manipulations no click suggestive of a sudden reduction of subluxation or luxation was noted.

On January 9, 1916 a second manipulation was done and the limbs again immobilized in further correction. The plaster was bivalved and the limbs massaged and manipulated daily. The patient was discharged from the hospital February 1 with condition greatly improved.

On June 4, 1916 the patient received the orthopedic service. The treatment prescribed had been somewhat neglected and as the result the patient showed but little improvement over the condition noted when discharged from the hospital in February. Examination revealed the following condition. A well developed full sized infant 18

months of age. With patient in dorsorecumbent position both lower limbs project upward almost to right angles with the body axis. The thighs are held flexed 50 degrees on the abdomen and slightly abducted but passively they may be extended to within 1 degree of normal full extension. All other movement at hip normal. The knees are held in hyperextension the leg forming an anterior angle of 100 degrees with the thigh. Passively the knee may be flexed to 50 degrees on the right and to 70 degrees on the left side. Further flexion causes pain to the child. Sudden release of a limb thus corrected results in its immediate return to its vicious position but with a suddenness less marked than noted at earlier observations.

On the anterior surface of the knees the cutaneous folds are plainly visible. There are two on the right three on the left the latter being especially well marked and deep. Flexion of the knee does not obliterate them. Careful palpation reveals the presence of both patellae not felt at earlier examinations. They are small and situated somewhat higher than normally.

Owing to the well nourished condition of the infant and the presence of marked fat pads around the knee one cannot determine the presence of any abnormal prominence of the tibial head anteriorly or the femoral condyles posteriorly. There is slight lateral mobility of the right knee with some abduction in deformity.

The right foot shows a talipes equino valgus the left talipes equino varus. The valgus and varus are correctable the equinus only so to a limited degree (Fig. 6).

Measurements of both limbs equal. X-rays reveal a relation of the articular surfaces similar to that noted in the earlier plates but to a less marked degree. Figure 4 is a lateral view of the left knee taken in June 1916. The degree of hyperextension is shown but the element of subluxation is much less marked than in the other plate. The patella is quite distinct and situated opposite the lower portion of the femoral diaphysis. The quadriceps tendon is relaxed as shown by its tortuosity and apparently not responsible for the maintenance of the limb in its abnormal position. If the limb is flexed to 70 degrees as may be possible the tendon is tightened and the patella descends. With such direct evidence of the absence of the quadriceps as an obstacle to reduction one may be justified in assuming the capsule or possibly a condition of anterior subluxation of the flexor tendons to be the causative element in the maintenance of the deformity. The presence of the cutaneous folds already described is clearly shown. On June 13, under ether the knees were again manipulated and immobilized in plaster splints in a position of further correction. In addition a tenotomy of both tendons of Achilles with correction of the foot deformities was performed.

At the time of writing the child has its limbs retained in corrective plaster of Paris splints which



FIG. 3. Lateral view of right knee at nine months, showing the degree of hyperextension and the anterior subluxation of the tibia on the femur.

have been bivalved so that they may be removed daily and the limbs massaged and manipulated. When last seen flexion of the knees to 90 degrees was easily obtainable and the degree of hyperextension less marked.

*En route* this patient presented at birth the condition of double congenital genu recurvatum combined with a marked congenital flexion contracture of the thighs on the abdomen, a talipes equinovarus of the right foot and a talipes equinovarus of the left foot. The genu recurvatum is of the type *de velut* by an anterior subluxation of the tibia on the femur. There is no evidence of any epiphyseal separation or vicious union.

Treatment, consisting in progressive manipulations with and without narcosis, massage, and retention of limbs in corrective positions by means of plaster-of-Paris splints, has resulted in a gradual and encouraging diminution and correction of the deformities.

#### SUMMARY

A careful review of the literature has shown that the congenital malformation clinically known as a hyperextension of the leg on the thigh may be represented anatomically by a condition ranging from a simple hyperextension with no element of luxation through all degrees of subluxation to an actual anterior luxation of the tibia on the femur; that in the majority of cases the deformity is one of



FIG. 4. Lateral view of left knee at eleven months. Note the height of the patella with the relaxed quadriceps tendon.

anterior subluxation in which the tibia is partially in front of the femur, often at the site of the displaced patella; the quadriceps shortened, the patella small and high being situated on the anterior face of the lower end of the femoral shaft. The flexor tendons may be luxated forward to become extensors and in a few cases anteversion of the femoral epiphysis has been noted.

To attempt to designate a malformation represented by so many degrees of deformity by a term which is descriptive of but one type



FIG. 5. Child at six months, showing hyperextension. Flexion contraction of the thighs on hips also present.

FIG. 6. Child at six months. Note the equinovarus of left foot and equinovarus of right.



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ACUTE INFLAMMATION OF THE NECK OF THE FEMUR<sup>1</sup>

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THE writer began his observations upon this subject more than twenty years ago and nineteen years ago first called attention to the fact that the disease involves the neck of the femur on the diaphyseal side and that the separation of the head of the femur is due to the infection on the diaphyseal side and not to an inflammation of the epiphysis and suggested therefore that the term epiphysitis is a misnomer.

MacNamara suggested the name of acute epiphysitis in the first edition of his classic work on diseases of the bone but in the third

edition published in 1887 he states that exception has been taken to the term epiphysitis because in many of the cases the diaphysis is entirely destroyed but the epiphysis continues to live and grow. He states however that the objection is somewhat fallacious, because the epiphysis is acutely inflamed in these cases and is not destroyed because its blood supply is independent of that of the diaphysis. The writer has demonstrated that the real infection in these cases takes place invariably on the diaphyseal side of the epiphysal line in this disease just as it does in osteomyelitis in other locations and

This paper is agreed to be published in the A. S. of S. for April 1916 under the title of "Osteomyelitis Involving the Epiphysis." Condition: Irregularly Erroneously Described Acute Epiphysitis.



that the free blood supply of the epiphysis protect it from infection.

In every one of the many cases operated upon by the writer the disease has been limited to the neck of the femur and in a few in which the diagnosis has been made early and drainage established the disease has been cured and the epiphysis has not been separated. The majority of cases have come under observation after the disease had made some progress and after separation of the epiphysis had taken place not because of inflammation in the epiphysis itself but because of the disease on the diaphyseal side in the neck of the femur.

In the previous paper already mentioned apology was made for the use of the term osteomyelitis involving the hip joint because there is a medullary cavity in the neck of the femur and in existing doubt for a suitable name for this disease Dr C. M. Jackson, Prof. of Anatomy in the University of Minnesota was first consulted who stated that the term osteomyelitis of the neck of the femur is not necessarily incorrect as the spaces of the cancellous tissue of the neck of the femur contain marrow which may be involved and suggested that this is a matter for the pathologist to decide. Dr Jackson suggests as a possible substitute for the term epiphysitis *femoral apophysitis* since the neck of the femur being an outgrowth from the shaft of the femur is an apophysis and cites a precedent already established by the term *apophysitis tibialis et olecrantem* or Schlatter's disease.

Dr H. L. Robertson, Professor of Pathology in the University of Minnesota states that the term osteomyelitis of the neck of the femur is not pathologically incorrect for although there is no definite medullary canal in the neck of the femur there are red marrow cells all through it which may be the seat of an infection so that on the whole the term osteomyelitis of the neck of the femur seems to the writer to be the most distinctive title because it states clearly just what the condition is and the clinical history of this disease is exactly that of osteomyelitis elsewhere.

Most writers in discussing this disease speak

of it as a rare one but the writer's experience leads him to believe that its apparent rarity is due to the fact that it is so commonly overlooked for he has constantly under observation patients suffering from this disease. At the present time we have three cases in the University Hospital and we have had five in one month. Of all the cases of this disease admitted to the University Hospital in only one has a correct diagnosis been made before admission and that one was seen by Dr. Law, a member of our hospital staff.

The fact that the neck of the femur is deep seated makes the diagnosis somewhat more difficult than it is in the average case of osteomyelitis. The prognosis is much more grave because the disease is so located that when Nature relieves the pressure in the center of the neck of the femur by breaking through the shell of bone into the surrounding parts the infecting material necessarily breaks into the hip joint and we have added to the original disease suppurative synovitis of the hip joint. In the writer's experience the disease has always occurred before the eighteenth year of age and during the time of development and growth of bone.

#### CLINICAL HISTORY

For convenience of study the writer deems it wise to divide this disease into three classes: the very acute, the medium or average type and the subacute. This division resting entirely upon the severity of the disease because the pathology is alike in all cases.

Fortunately the majority of cases are of the second class that is of *medium severity* which we will now describe. The disease begins with pain in the hip joint extending down the thigh is frequently accompanied by a severe rigor which is promptly followed by profuse sweating and rapid rise of temperature usually up to 104. Within forty-eight hours there is a certain amount of effusion into the hip joint the inguinal fold is partly obliterated and a difference in the contour of the two sides is quite noticeable and sometimes there is marked swelling of the upper part of the thigh. The patient holds the afflicted limb flexed and abducted

and objects to any effort to move it. There is marked leucocytosis and the polymorphonuclears run high. Blood examination is usually negative. The urine may show slight amount of albumin but is usually negative. The roentgen examination at this time is negative.

*The subacute variety.* It should be remembered that this disease may be so mild from the outset that a very careful examination is required to make a diagnosis and the disease is very liable to be overlooked. But even in these mild cases the tendency is for the disease to go on and destroy the neck of the femur, separate the epiphysis and to involve the hip joint and although the danger to life is not nearly so great the final result is apt to be just as disastrous to the joint as in a case where the disease is more acute.

*The acute type.* In this class of cases the infection is so overwhelming that the patient becomes delirious, his life is in jeopardy, the hip joint is destroyed at a very early stage and there is a marked tendency for a dissemination of the disease to other bones and joints. We have two such cases in the University Hospital at the present time and one was admitted last month who died within a few hours from general sepsis although the disease had existed but five days. This type is particularly prevalent among young children and the delirium comes on so suddenly that it is very apt to obscure the symptoms and make the diagnosis particularly difficult. In this type blood culture will frequently show streptococci and occasionally staphylococci.

#### DIAGNOSIS

In the average case a diagnosis can be made by a careful observer without great difficulty. The clinical history is already told should lead to a careful physical examination. Notwithstanding the fact that the joint is exquisitely sensitive and the patient objects to having the limb handled a skillful hand can gently manipulate the joint in such a manner as to determine whether the head of the femur is still attached and whether it moves normally in the acetabulum. A careful examination of the bones of the healthy

leg should be made first for sake of comparison and in order to gain the patient's confidence. To make an accurate diagnosis early it is necessary to take advantage of the well known fact that at a very early period the periosteum immediately over the central focal infection becomes exquisitely sensitive. The surgeon should grasp the tibia of the afflicted side gently between his thumb and fingers making pressure upon the periosteum of the tibia so as to exclude osteomyelitis of that bone. He should then grasp the femur just above the condyles making gentle pressure upon the periosteum with his thumb and fingers. He should very carefully follow up the shaft of the femur and he will find that he can make direct pressure on the periosteum throughout the length of the femur without causing pain. At an early date he may even make pressure directly over the great trochanter crowding the head of the bone into the acetabulum without causing pain. If he will then pass one hand underneath the patient so that the points of his fingers rest over the hip joint posteriorly and will make pressure over the anterior surface of the joint with his other hand pinching the neck of the femur between the ends of the fingers of the two hands the patient will immediately cry out on account of the severe pain and the diagnosis is unquestionable.

In every case where a child becomes suddenly delirious with high temperature and is evidently suffering pain the doctor should observe the patient's attitude bearing in mind that a very acute osteomyelitis often begins in this manner. When one of the extremities is held in a flexed and abducted position the whole extremity should be carefully palpated as previously described and even in delirious patients when direct pressure is made over the diseased point the patient gives unmistakable evidence of increase in pain. Unfortunately a roentgen examination is not helpful in the very early stages of the disease. Figure 1 is a roentgenogram of the limb of a patient who had an abscess in the neck of the femur but there is no evidence of it in the picture. Later in the disease roentgenograms are very helpful.

## PROGNOSIS

In the average case the prognosis for both life and limb is remarkably good provided the diagnosis is made promptly and proper treatment applied. In the very acute cases the danger to the patient's life is very great because of the marked tendency to a general dissemination of the disease. The danger to the joint is also great because the difficulties of diagnosis are such that the neck of the femur may be destroyed and the epiphysis separated before a diagnosis is made. In the milder type of cases the prognosis is good again provided the diagnosis is made within a reasonable time. The great danger in this type of cases is that owing to the extremely mild course of the disease the diagnosis may not be made until the head of the femur has been separated. In the writer's former paper a case was cited in which the disease developed in a patient while in the hospital suffering from osteomyelitis of the tibia but the symptoms were so mild that special attention was not drawn to the hip until separation of the epiphysis had taken place. In some of the mild cases in which the diagnosis has not been made and the proper treatment has not been applied Nature may relieve the patient by breaking through the soft parts allowing escape of pus. These cases are usually pronounced tubercular but when the operation is made the neck of the femur will be found necrotic, the epiphysis floating loose in the joint and the patient will make a wonderfully prompt recovery after the operation. When the trochanters are preserved as they always should be when operating for this disease Nature usually establishes a remarkably good artificial joint by bringing the upper end of the femur close to the acetabulum and attaching it there.

## TREATMENT

The treatment is prompt and efficient drainage of the affected part. In our experience the most satisfactory results have followed drainage directly through the joint from the front and opening into the neck of the femur just as would be done were the disease in the lower end of the femur.

MacNamara suggested that we should make an incision over the great trochanter and drill through the trochanter into the center of the neck of the femur and drain the infected part so as to prevent infection of the hip joint. In one of the cases reported in this paper early diagnosis was made and MacNamara's operation performed. An abscess was found in the center of the neck of the femur and drained through this opening through the trochanter. Notwithstanding the fact that there was no evidence of infection of the hip joint at the time of this operation the drainage through this trochanteric opening was insufficient and the joint later became infected and was drained before the head of the bone had become separated.

With the patient lying supine an incision should begin just below the anterosuperior spinous process of the ileum and extend downward between the inner margin of the tensor vagina femoris and the outer margin of the sartorius. The vessels are well to the inner side of this incision and are in no danger. Blunt dissection should then be made down to the capsule of the joint and the parts well separated by blunt retractors. Even at a very early stage of the disease the soft parts in front of the joint are usually oedematous and the surgeon realizes early in his operation that he is approaching the center of infection. A free opening should then be made through the anterior wall of the capsule of the joint and the neck of the femur carefully examined by the surgeon's finger. The condition of the joint will depend entirely upon the stage of the disease. At a very early stage there may be little or no change in the joint or there may be some effusion of serum. At a little later stage the joint capsule will be distended with pus. At a still later stage the neck of the femur will be found necrotic and the head of the bone separated.

In the very early case notwithstanding there is no evidence of infection in the joint the surgeon should unhesitatingly make a drill hole directly into the neck of the femur well toward the epiphyseal line. This drill hole should be large enough to admit the introduction of a reasonable sized rubber



Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 1 Roentgenogram Case 1 taken May 10, 1916. The patient had an abscess in the neck of the femur which is not found in the picture.

Fig. 2 Case 1. Roentgenogram taken May 17 after operation. Drainage tube inserted.

Fig. 3 Case 1. Taken June 22 after third operation.

Fig. 4 Case 1. Roentgenogram taken June 22 after third operation. Right drainage tubes introduced and Buck's extensor applied.

Fig. 5 Case 1. Roentgenogram taken when patient left hospital. Septal bone showing regeneration of bone and the epiphysis in normal position.

drainage tube. At this very early stage the surgeon may find little evidence of infection but his patient will be relieved and the temperature will drop immediately as beautifully illustrated in one of the cases reported in my former paper. We all know that in cases of osteomyelitis in other locations when we operate at a very early stage we may not find pus in the medullary cavity but that our patients are promptly and permanently relieved of their pain and temperature by the operation and we have demonstrated that the same holds true in this operation. In the early cases a rubber tube should be passed into the drill hole in the neck of the femur and fastened in this position. The joint capsule is then loosely closed about the tube and the wound closed.

In cases further advanced where there is already necrosis in the neck of the femur but in which the epiphysis has not yet been separated the sequestra should be removed and drainage established. At a still later stage when the epiphysis has been separated it should be removed together with the diseased portion of the neck. The trochanters should not be removed as they are in tuberculosis of the hip because they are not involved in the disease and will be helpful in establishing an artificial joint. It is the exception when these patients recover after a single operation. They must be watched carefully and additional drainage established whenever a decided rise of temperature occurs.

The following cases coming under the writer's observation in the University Hospital within the past few months will illustrate the various points made in the paper.

CASE 1. This case is of the medium or average type. On May 10, 1916 H. M., age 11, was admitted to the medical side with a tentative diagnosis of rheumatism. His previous history was negative. On May 12, four days before admission, he awakened with severe pain in the right groin just below Poupert's ligament in the region of Scarpa's triangle. He got up and was about that dry until noon when he went to bed where he had been up to the time of admission. After going to bed he had a severe chill followed by sweating. He lost his appetite and was unable to sleep. There was flexion and abduction of the thigh with slight swelling over the hip joint in front. Physical examination demonstrated that by careful manipulation the joint could be moved in all directions and that there was evidently no separation of the head of the femur. Direct pressure over the neck of the femur caused excruciating pain. A roentgenogram (Fig. 1) was negative. His temperature on admission was 102.8° pulse 110. There was nothing of special interest in the urine: leucocytosis 12000, polymorphonuclears 72 per cent. A diagnosis of acute osteomyelitis of the neck of the femur was made by Dr. Corbett. On May 17, the fifth day of the disease, the patient was admitted to the surgical ward. His temperature was 103.9° and his pulse 112. On the same day he was operated upon under ether anesthesia by Dr. Corbett. An incision was made over the great trochanter and a bone drill passed through the trochanter along the center of the femur. After passing into the bone about two and a half inches an abscess containing about one ounce of pus was found. A rubber drainage tube was introduced (Fig. 2).

The next morning his temperature was 100.5°.

tion vary to a large degree with the situation of the ulcer having been confirmed it was necessary in order to obtain a fair estimate of results to classify gastric ulcers into the following groups

- 1 Ulcers near the pyloric outlet
- 2 Ulcers on the lesser curvature
- 3 Ulcers on the posterior wall
- 4 Ulcers on the anterior wall
- 5 Ulcers producing hour glass contraction

Certain principles hold true in the treatment of all gastric ulcers. While the frequency with which gastric carcinoma is preceded by ulcer may be a basis for argument it must again be emphasized that gastric ulcers do at times become carcinomatous. The premise therefore that gastric ulcer should if possible be excised or destroyed may be accepted as logical. The routine adherence to such a principle however is difficult from a technical standpoint and the absence of positive signs of malignant change may persuade the surgeon against his better judgment to base his treatment on the assumption that there is no malignancy. Although fully recognizing the importance of the removal of the ulcer bearing area because it is a potentially malignant lesion we must also bear in mind the fact that malignancy with comparative rarity develops in a gastric ulcer for which gastro enterostomy alone has been done.

Unfortunately there is no certain method of consistently determining early malignant invasion of an ulcer. In some instances valuable suggestive evidence is found in the history of the patient the X ray findings and the chemical characteristics of the gastric juice while in others positive proof is obtained by gland examination. The transitional stage between ulcer and cancer cannot be detected at the operating table and a segment of the ulcer excised for examination although cancer cells may be present in other portions of the base.

The extent of the induration and the degree of its activity must be taken into careful consideration in arriving at a decision as to the operation of choice. An inflammatory mass

of large size with gross evidences of subacute perforation as a rule precludes excision or resection while perigastric extension sufficient to involve other organs such as the liver or pancreas should usually be a warning against attempted removal.

1 *Ulcers in the pyloric outlet* In this group there were 197 ulcers 29 per cent of the total. It seems to be indisputable that ulcers close to the pylorus are more readily amenable to successful surgical treatment than those in any other portion of the stomach (Brewer 1 Woolsey 2 and others). Particularly when mechanical obstruction has occurred from contraction of the ulcer or by reason of its actual size operation is followed by eminently satisfactory results. The technical difficulties incident to the removal of such ulcers are less than those encountered with other gastric ulcers but their surgical treatment demands more mature judgment as to the correct operative procedure to follow. It is difficult for example to determine whether early malignant change has occurred in such ulcers and inasmuch as usually the pyloric end of the stomach including the ulcer area can be resected without prohibitive added risk considerable responsibility is assumed in deciding that a suspicious lesion at the outlet is not malignant. Conversely the decision that a lesion is malignant may mean an unnecessary resection. When long continued obstruction has produced a degree of emaciation which permits of only a gastro enterostomy the error of assuming the growth to be malignant may result in an unnecessary pylorotomy later. It is in this type of case also that occasionally a hopeless prognosis is given to the patient and in which a palliative gastro enterostomy for the supposed extensive carcinoma is followed not only by relief of symptoms but by a return to permanent good health.

The relative frequency of operations from January 1 1906 to November 1 1916 for gastric ulcers near or involving the pylorus is shown in Table I.

2 *Ulcers on the lesser curvature* These comprised 316 of the gastric ulcers 46.6 per cent of the total being thus considerably the most common type especially in view of the

TABLE I

	No.	N of Cases	Per centage
Posterior gastro-enterostomy		105	53
Pylorotomy (Rodman Billroth No 1)			
Polya and others	41	30	
Excision and pyloroplasty	13	6	
Cautery and gastro-enterostomy	11	5	5
Anterior gastro-enterostomy	10	5	
Pyloroplasty	8	4	
Excision and gastro-enterostomy	7	3	5
Excision	1	0	5
Reinforcement	1	0	5
Closure	1	0	5
Total		197	

fact that many of the ulcers classified in the preceding group i e ulcers in the pyloric outlet, developed on the lesser curvature. Their tendency to localize on the lesser curvature and to spread on to both anterior and posterior walls of the stomach accounts for the term saddle ulcer. It has been our experience however that such ulcers tend to extend to the posterior wall rather than to the anterior wall. These ulcers frequently illustrate in a marked degree the discrepancy in size between the area of induration and the actual crater of the ulcer. It was in these lesser curvature lesions that the cautery was first employed as a surgical measure. A sufficient number of patients have now been operated on by this method to prove its safety and efficiency and our own observations have been confirmed by others particularly Scudder and Harvey (3).

Lesions are repeatedly found in which excision would be inadvisable and of decided risk on account of the wide area of induration and of the inaccessibility of the ulcer due to its high situation on the lesser curvature but in which complete destruction of the crater of the ulcer can be accomplished with the cautery. For lesser curvature ulcers the operations shown in Table II were performed.

3 *Ulcers on the posterior wall* There were 63 ulcers on the posterior wall constituting 9.8 per cent of the series. These have an added surgical interest since, with the problem of the local treatment of ulcers various routes to gain access to the ulcer may be chosen by the surgeon e g through the gastrohepatic omentum through the meso-colon by separation of the omentum from the transverse colon (Pauchet 4) or

TABLE II

	No of Cases	Per centage
Posterior gastro-enterostomy	93	16.6
Excision	72	20.6
Cautery and gastro-enterostomy (two years)	62	17.7
Excision and gastro-enterostomy	37	10.6
Pylorotomy	20	5.7
Gastrogastrostomy	14	4.0
Anterior gastro-enterostomy	11	3.0
Sleeve resection	10	2.8
Pyloroplasty	8	2.0
Cautery and pyloroplasty	7	2.0
Excision and pyloroplasty	7	2.0
Jejunostomy	3	0.8
Exploration	2	0.5
Suture compression	2	0.5
Reinforcement	1	0.2
Total	349	

through the anterior wall of the stomach. If the crater of the ulcer is not of large size and there is little evidence of peritoneal irritation about the ulcer area its excision may be attempted. Even if the ulcer has perforated into the pancreas it may be still possible and safe to separate the stomach from its resulting attachment trim out or sterilize the edges of the ulcer and close the defect. The operations shown in Table III were used in this group.

4 *Ulcers on the anterior wall* Ulcers on the anterior wall constitute a relatively small group there being but 17 in the series 2.5 per cent of the total. Such ulcers are easily excised by knife or cautery unless perforation has occurred with attachment to the anterior abdominal wall. Table IV gives the operations performed in this group.

5 *Ulcers producing hour glass contraction* In the group of ulcers producing hour glass contraction are 58 cases. The characteristic deformity warrants a separate classification although the contraction may be produced by an ulcer of the anterior or posterior wall or an ulcer of the lesser curvature. These are most interesting from a surgical standpoint for they tax the resourcefulness and skill of the surgeon and stimulate his ingenuity.

A wide variety of operative procedures are at the choice of the surgeon the selection being governed by the condition of the patient the pathologic findings and the capability of the surgeon. The ulcer which has produced the deformity may be so situated

TABLE III

	No. of Cases	Per centage
Posterior gastro enterostomy	17	
Pyloroplasty	1	5
Exc. on and gastro enterostomy	6	0
Gastrogastrostomy	8	
Pyloroplast	0	7.5
Cautery and gastro enterostomy	6	7.5
Anterior gastro enterostomy	5	6
Exc. on	5	6
J. junostomy	4	5
Cautery and p. loroplasty	4	5
Exc. on and pyloroplasty		5
Sleeve resection		5
R. f. resect		5
Closure		
Total	80	

TABLE IV

	No. of Cases	Per centage
Exc. on	6	5
Pyloroplasty	5	20.8
Cautery and gastro enterostomy		20.8
Pyloroplast	3	5
Posterior gastro enterostomy		8.3
Exc. on and p. loroplasty		8.3
J. junostomy		4
Total	24	

that resection of a complete segment including the ulcer and the scar may be possible. This operation which entails an end to end union of the resected stomach has given excellent results in our hand and has been reported upon favorably also by others (Haines 5).

It has been recently shown by Stewart and Barber (6) that after sleeve resection the motility of the stomach more nearly approximates the normal than it does after resection of a V shaped segment from the lesser curvature.

However this or in fact any type of resection is not always possible for the ulcer may have become so firmly fixed that the stomach cannot be mobilized under which circumstances drainage must be procured either by gastr gastrostomy or by gastro enterostomy on the proximal or distal segment of the stomach. Should the ulcer be situated on the anterior wall and should the greater part of the scar be accessible satisfactory results may be obtained from excision of the ulcer or from puncture with the cautery point and correction of the original deformity by a gastroplasty.

The operations which have been done in the Clinic for hour glass contractions are given in Table V.

In the compilation of these statistics the mortality records detail important information as to the relative risk of the various types of operation as well as the risk according to the situation of the ulcer.

In Tables VI and VII although there are several figures to which I might allude I would draw attention to the fact that in 87 operations by the cautery method combined with gastro enterostomy there was one death. Moreover in the case of this patient a double operation was done the primary operation being cholecystectomy for a septic gall bladder in the subacute stage. The necropsy report stated that the stomach was in perfect condition and that the cause of death was septic cholangitis.

In considering the results of the various operations employed in the treatment of gastric ulcer it would be advisable to state the basis on which these results were compiled. The information was obtained through a form letter sent to each of the patients operated on in the Mayo Clinic for gastric ulcer from January 1 1906 to July 1 1915. The letter was so constructed that we believe we have obtained an accurate estimate of the result of the operations for inasmuch as they were performed primarily for the relief of subjective symptoms the patients become the final arbiters as to the success of the treatment. It has further been our experience that those failing to reply to inquiries of this kind are likely to be enjoying good health. It should be noted that at least a year and a half has elapsed since the last case considered in this report. Criticism may be offered that the present health of the patients operated on as recently as 18 months ago is not a criterion of the late results but experience has shown that a recurrence of symptoms rarely develops after the patient has had relief for a year. It is also a fact that in the event of such recurrence it is due probably to the development of a new ulcer rather than to a failure to cure the original ulcer.

The results of operation in all cases of gastric ulcer are tabulated in Table VIII.

TABLE V

	N of Cases	Per centage
Gastrogastrostomy	23	39.0
Posterior gastro-enterostomy	8	13.8
Pyloroplasty	8	13.8
Sleeve resection	4	6.7
Cautery and gastro enterostomy	4	6.7
Pylorotomy	4	6.7
Anterior gastro enterostomy	2	3.4
Jejunostomy	2	3.4
Excision	2	3.4
Excision and pyloroplasty	2	3.4
Total	58	

TABLE VI—A SERIES OF 670 GASTRIC ULCERS ACCORDING TO TYPE OF OPERATION

(January 1 1906 to November 1 1916)

	Oper at ions	Mor tal ity	Per cent age
Posterior gastro enterostomy	228	4	1.7
Cautery and gastro enterostomy	87	1	1.1
Excision	84	4	4.7
Pylorotomy	77	6	7.7
Excision and gastro enterostomy	52	2	3.8
Anterior gastro enterostomy	27	1	3.7
1 Pyloroplasty	26	2	7.0
1 Excision or cautery and pyloroplasty	35	3	8.5
Gastrogastrostomy	23	4	17.4
Sleeve resection	12	0	0.0
Miscellaneous	10	0	0.0
Jejunostomy	8	1	12.5
Total number reported in this series	670	24	3.5

The mortality is not representative of pyloroplasty by the Finney method which in our experience only rarely cases less than a mortality of less than 3 per cent. The group of cases in which the operation was performed included a number of poor surgical risks with extensive local disease so that the operation was often one of expediency rather than one of choice.

TABLE VII—A SERIES OF 670 GASTRIC ULCERS ACCORDING TO POSITION

(January 1 1906 to November 1 1916)

	Cases	Per cent age	Mor tal ity	Per cent age
Ulcers on the lesser curvature	349	52	12	3.4
Ulcers close to or involving the pylorus	97	10	3	3.1
Ulcers on posterior wall	80	1	0	7.5
Ulcers on anterior wall	24	3	1	4.0

The percentages are based on information from 285 patients who were operated on previous to July 1 1915. Deaths which occurred months or years after operation are excluded in this report but are being carefully investigated and will undoubtedly contribute much desired information as to the life expectancy and the possibility of the

TABLE VIII—RESULTS OF OPERATIONS FOR GASTRIC ULCERS

(From January 1 1906 to July 1 1915)

	Per centage
Total number of patients heard from	285
Cured	159 55.7
Greatly improved	65 22.8
Slightly improved	28 9.8
No better	33 11.5
Satisfactory results	224 78.9

TABLE IX—RECAPITULATION

	Per centage	Per centage	Per centage	Per centage
Posterior gastro enterostomy	28	84	17	18
Pylorotomy	77	90	7	3.9
Excision and posterior gastro enterostomy	52	83	3	3.9
Cautery and posterior gastro enterostomy	87		1	0.0
Excision	84	57	4	32.0
Sleeve resection	12	90		
Anterior gastro enterostomy	27	7	3	3.8
Pyloroplasty	26	75	7	10.0

\*So little time has elapsed since the operation was first tried that statement regarding the present condition of the patients would be of no real value.

development of cancer as well as other fatal late complications in those operated on for gastric ulcer.

Table IX is a recapitulation of the results of the various operations for gastric ulcer with the operative mortality and the percentage of the patients so operated on who returned for secondary operations.

Table X is an abstracted compilation of these secondary operations.

There are certain facts in the tables which appear to justify emphasis.

1 For ulcers at the pylorus posterior gastro enterostomy is the operation of choice in the poor surgical risk for although pylorotomy is followed by better results the operative mortality is distinctly higher. The cautery is a useful adjunct in selected cases.

2 For ulcers on the lesser curvature cautery by the method described in a previous paper (7) and gastro enterostomy is the operation of choice.



TABLE X REPORT ON SECONDARY OPERATIONS ON GASTRIC ULCERS (47 CASES)  
6.8 PER CENT OF 670)  
(From January 1904 to November 1916)

Original Operation	Time since First Operation	Cause for Second Operation	Second Operation
Excision of ulcer	1 year 1 case 2 years 5 cases 3 years 2 cases 4 years 1 case 10 months 1 case weeks 3 cases 0-18 days 1 case	Obstruction at or below 1st ulcer lower glass distention at the 1st subacute perforation	Posterior gastro-enterostomy 1 and gastro-enterostomy 1. Adhesions found of the above cases. An excised and transference to another
Excision and posterior gastro-enterostomy	months 1 case 6 days 1 case	Obstruction from knifed pylorus Obstruction and abscess	Anterior gastro-enterostomy drainage of abscess pyloroplasty and fistula
Excision and pyloroplasty	years 1 case year 1 case month 1 case	Ulcer Abscess	Cautery and posterior gastro-enterostomy excision and gastro-enterostomy or gastro-enterostomy 1 and 2 scars
Pyloroplasty	6 years 1 case 3 years 1 case 3 days 1 case	1 ulcer at 1st Last border of stomach Acute obstruction and distention	Anterior gastro-enterostomy (Murphy's transverse colon resection and re- section of stomach and pyloroplasty drainage at 1st
Anterior gastro-enterostomy	week 1 case	Bleeding at 1st	Enterostomy (Murphy's button)
Posterior gastro-enterostomy	year 1 case year 1 case weeks 1 case days 1 case	Ulcer 1 ulcer excised at 1st glass	Excision of abscess enlargement of enterostomy at 1st and 2nd of pylorus
Gastro-enterostomy	years 1 case years 1 case year 1 case month 1 case	Lower glass at 1st and 2nd bleeding at 1st and 2nd obstruction	Posterior gastro-enterostomy gastro-enterostomy anterior gastro-enterostomy and splenectomy
Excision and drainage	years 1 case	Pyloric obstruction	Posterior gastro-enterostomy
Excision and drainage	1 year 1 case	Ulcer	Excision of pylorus

3 Local excision alone of such ulcers is inadequate 32 per cent of patients so operated on ultimately requiring further operative treatment viz gastro enterostomy

4 Sleeve or segmental resection especially in large high ulcers and hour glass contraction in suitable cases is not only a relatively safe operation but has been followed by good results

5 The lowest operative mortality in the more common operations was associated with cautery and posterior gastro enterostomy

6 Ulcers on the posterior wall are associated with the highest operative risk while those at the pylorus are of least risk

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# DEPARTMENT OF TECHNIQUE

## GENERAL RULES USED IN SIMPLE PLASTIC WORK ON AUSTRIAN WAR-WOUNDED SOLDIERS

By DR. J. F. S. ESSER ARNHEM HOLLAND  
Dutch Special Surgeon for Plastics

FOR eight months in 1915 I was chief surgeon of the Royal Reserve Hospital No. 2 in Bruenn Moravia with more than 3,000 beds. Here I did more than 400 plastic operations. The cases were sent to me from all Moravia by military command of the late chief army surgeon, Dr. Schwarz, and later on by a further order from his Excellency, Lieutenant Field Marshal Poeschmann, through whose order I could select such cases in every hospital there.

Because of my success in these cases as well as in the cases operated on afterward in the Royal Reserve Hospitals Nos. 8 and 17 and in the university clinic of Professor von Hochenegg in Vienna, I shall describe some principles in technique which I particularly recommend. I shall not mention here the complicated face plastics, those with free transplantation, and those with application of pedicle flaps from distant parts of the body, nor shall I describe æsthetic operations or plastics on the skull and other parts of the body.

As a rule I make my technique in plastic operations as simple as possible. I prefer to cover defects of the face with tissue from the immediate neighborhood, contrary to the general rule as shown in the works of nearly all plastic surgeons. I avoid, when possible, the application of pedicle flaps from a distance. I follow this principle not only because the technique is simpler, but chiefly for æsthetic reasons.

The result in most facial plastics would seem to indicate that the surgeon is chiefly concerned in seeking the easiest and surest way to success without considering that intervention must also in nearly every patient, satisfy his sense of beauty.

It is certain that not every surgeon, however distinguished, is qualified to do facial plastics, and this is especially true if he does not appreciate the æsthetic and has not a thorough understanding of all the requirements. He must be blessed with the rich gift of invention and must possess as well mathematical and economical knowledge. I will only mention the great re-

sponsibility as far as the patient is concerned. He concentrates all his hopes on attaining a beautiful result. Even after very exhausting operations consuming 4 or 5 hours performed without an anæsthetic, the first request the patient makes is almost always for a mirror. With the smallest imperfection, especially as regards hair, it is striking to find that even the rudest peasant continually begs for correction.

I combine all facial plastics, therefore, because the first consideration is the good appearance of the patient. This requisite distinguishes plastic operations from all other operations which have for their object a practical result.

Æsthetics play an important role in facial plastics. Every one who has had occasion to converse with mutilated patients knows how great deformities influence their composure, how ever much they try to conceal their embarrassment. It is not sufficient merely to close facial defects, however perfect the result may be from a surgical standpoint; the operation must be done so as to insure the patient not only a perfect result surgically but his face must be restored as nearly as possible to its normal appearance.

In the first place the foundation for the plastic must be suitable. A potato-like formation with two outward openings is not a nose, however well healed and vascularized it may be. The muscles of expression must be considered, fat tissue must be provided, and lastly the skin to be used must be chosen so that it closely resembles the skin in the area to be covered in color, shade, elasticity, hair thickness, fiber direction, number and size of the pores, in short in all its qualities.

We very often see patients who have been dismissed after a plastic as recovered in whom only the defect has been closed, and the modeling not yet done. I maintain that a soldier who has done his duty and has risked his life fighting for his Fatherland has the right when he is mutilated, to demand from the same Fatherland that it do all in its power to restore him to

normal. I mention this for however reasonable it may seem many surgeons do not agree with me.

The social side of life must be given due consideration in deciding on the indications for plastic operation. The patient who returns to society after an excellent operation feels happy and as newborn. Those who have suffered mutilating injuries to the face have the greatest desire to be operated upon as soon as possible. Thus it is seen that plastic operations upon the face are in many ways as important as are the more common operations for while they may not save the patient's life they do help to alleviate pain and to free the patient from many distressing conditions such as the inability to eat breathe or speak properly as well as the inability to retain saliva.

In doing these operations the entire face must be considered because operations for the correction of one part must not mutilate another part and when the defects interlap especial care must be exercised.

The most essential principle in all plastic operations is simplicity. Simplicity facilitates the work and preserves the beauty. The use of skin from a nearby surface is therefore to be preferred to skin from distant parts. In almost every instance even in very large defects this principle of technique can be carried out. The one point necessary is that the parts be made sufficiently movable either by cutting on one side (half pedicled) or when necessary with entire pedicles. When this is not possible I use a pedicle flap from a distant part or a free transplant. The general opinion that this local treatment causes deformities is false. The result depends on the technique.

However plausible it may seem to use neighboring tissue most plastics have been treated otherwise. The careful use of the above mentioned principles often forces one to enter new paths and work independently as many existing operations for certain defects are contrary to this rule of simplicity. This axiom applies to small defects for which when possible I apply the simple lineal seam in cases where many other surgeons use pedicle flaps and free transplants. Some of my cases will show this. I would only say that I take much trouble to make every seam as nearly perfect as possible. By this care in details and the success of the plastic operations increased and brought nearer to the ideal.

For control I always have the interesting cases photographed from three sides both before and after operation. Care is taken to get all the photographs equally sharp and no retouching is

done. Some of my photographs from Bruenn are not good because my photographer had to go to the front.

When the wound edges fell in I undercut the fat and muscle tissue and by layers of sutures brought them together in a ridge exactly beneath the suture line. It is of great importance that this ridge of fat and muscle follow exactly the suture line so as to raise the wound edge to the level of or a little higher than the surrounding part (Figs F to I).

As mentioned above the aesthetic advantage of using skin bordering on the defect is that it corresponds better in quality color shade elasticity hair thickness fiber direction number and size of pores than is the case with pedicle flaps from forehead temple or neck not to speak of the skin of the chest or arm.

The fear of many surgeons of extropion and partial immobility after lineal sewing of facial defects is groundless in carefully chosen cases and with good technique. This fear has stood in the way of the finer development of the technique governing their dangers.

However imposing the genial work of Lexer on free transplant is it should not lead to a general usage of the same. They may be used only when a pedicle flap is impossible.

Before entering into details of the different groups I wish to mention a few general principles. Above all I lay the greatest weight on strict asepsis. One often hears from experienced surgeons that much may be tolerated in the neighborhood of the mouth and nose because these tissues through their rich blood and lymph supply more easily resist bacteria. In their opinion so much impurity which cannot be removed is always present that one need not be so careful about the asepsis. This is not the case for two reasons. First while these tissues can defeat many infectious germs they are resistant only against those belonging to that region. Therefore one must avoid introducing foreign bacteria here just as one does in pure tuberculous abscesses. Because of the great richness in blood and lymph vessels the fight between bacteria and tissues usually decided rapidly in favor of the individual but during this short time a greater danger of general infection exists or for spreading of infection (meningitis) than in tissue with few vessels. Secondly a disadvantage of non aseptic procedure is the less beautiful healing. Only wounds which heal by first intention, can, when all other circumstances are favorable give good results.

Before the operation the skin is shaved using no moisture and then painted with tincture of



For full description of plates see case reports  
Figs 1 and 2 Case 1 Gunshot wound of chin Fig 2  
Result after plastic

Figs 3 and 4 Case 2 Fig 4 shows a scar scarcely  
visible due to the fact that the pressure is borne by deep  
sutures

Figs 5 and 6 Case 3 Gunshot wound of upper eyelid  
Figs 7 and 8 Case 4 Gunshot wound of the ear  
Figs 9 10 and 1 Case 5 Shot through under lip  
The red of the lip was reconstructed with great care one  
of the most difficult tasks in plastic surgery. The result  
was very satisfactory

iodine. During the operation the skin is kept as dry as possible.

I use local or regional anesthesia for all face plastics. As small quantities as possible of anesthetic solutions are used because I believe that the tissues are not indifferent to and that their defensive powers are reduced by even a weak solution of novocaine and adrenalin. For the same reason I do not infiltrate far around the wound but into the same so that most of the fluid injected escapes during the operation.

Further the greatest cure is used in the total excision of all superficial and deep scars. This is conducive to a more beautiful form and also when the muscles are sewn carefully together to

a restoration of the power of expression. Besides later shrinking of the scars is avoided. Even in rather large defects with lineal seam I allow no tension in the skin itself. All tension is borne by the deep hidden sutures. I seldom use very large deep sutures from the surface on metal plates as Lindemann does because pressure necrosis frequently occurs beneath the plates leaving ugly scars. For diminishing new defects this method is excellent.

Upon finishing the operation some calomel is blown from a pulverizer on and around the wound which is then left uncovered when there is no special reason for bandaging. The advantages of the uncovered wound are many especially in



Fig. 12 to 4 Case 6 J. cheek injury  
 Fig. 5 to 7 Defect of upper lip Fig. 6 also the prominence of the upper  
 lip after repair

the presence of mouth, nose, and eye secretions. The skin does not macerate but remains dry so that the growth of bacteria and their inoculation of the wound does not occur. Light and especially sunlight bring access to the wound acts as a disinfectant and as a stimulant to the tissues.

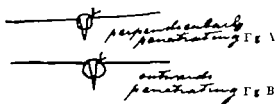
For the past two years I have powdered the wounds with calomel and am very well satisfied with it. First it dries the wound and is then diffused into the very small scabs. Traces of the sublimate are formed constantly from the calomel. In a nascent state these are very bactericidal. I have never observed a deleterious effect from the use of calomel, which is reasonable since even the conjunctival sac tolerates its presence.

That sick rooms may not be dusted is obvious but must instead be cleaned with a damp cloth.

The dry wound edges do not so easily permit gaps in places where there is a slight difference of tension as a loose soft skin would under a bandage. They either unite smoothly throughout or gape entirely (which accident does not often occur).

The uncovered wounds permit of regular and frequent inspection and when necessary removal of one or more stitches. The stitches always lie very close to each other and enter not toward the wound edge but perpendicularly or receding further from the edge (Figs A and B). Stitches are never put in exactly at the wound edge because then the knots are easily drawn into the cut causing unsightly and uncertain results.

I lay great weight on the absolute immobilization of the wound which principle is acknowledged everywhere at the present time. I forbid the patients to speak or to move their lips. I usually order only liquid diet which is given through a rubber tube. So necessary do I re-



gand immobilization that for a few days in many cases I forbid the very important rinsing of the mouth, even after operations which involve the inside of the mouth. Sometimes in these cases I allow the nurse to syringe the mouth with the greatest care. Thin soups are preferred rather than milk, because they do not leave so much impurity.

I divide simple free plastics into the following groups of which I shall discuss typical cases

- 1 Simple lineal seam
  - a After scar excision
  - b After scar and skin excision
- 2 Complicated lineal seam
  - a With underlay from direct neighborhood
  - b With underlay of free transplanted fat
  - c With alteration of skeleton
- 3 Seam with displacement of one wound flap after mobilizing it by simple cut
  - a With very large basis
  - b With narrow pedicle
  - c With island flap
- 4 Seam after mobilization of both flaps

#### I a SIMPLE LINEAL SEAM AFTER SCAR EXCISION

I will present many cases of this group in order to show how a very considerable number of different deformities which are often treated with rather complicated plastics can be helped in a most simple manner.

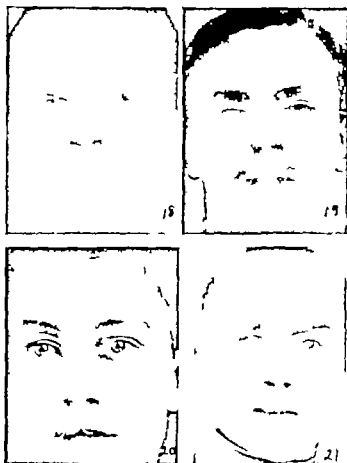
CASE 1. Lieutenant R. Vereins Reserve Hospital No 1 in Brunn (Figs 1 and 2) had a gunshot of the chin which healed with many scars after the excision of which the surroundings were simply sewn together.

CASE 2. Infantryman M. Royal Reserve Hospital No 8 in Vienna (Figs 3 and 4) came under my treatment for a gunshot of the jaw which I repaired with a local bone plastic. The protruding nail in the chin perforated the entire right lower jaw to fix the fragments and transplant. I present him here only to show that it was possible to take the large angoma from the forehead, the defect of which was simply sewn together after mobilizing the wound edges. Figure 4 shows that a seam even under great tension can be sewn together leaving a scarcely visible scar when great care is taken that the pressure is borne by the deep sutures.

CASE 3. Infantryman S. Royal Reserve Hospital No 2 in Brunn. A defect of the upper eyelid from gunshot wound (Figs 5 and 6) was closed with a lineal seam after freeing the wound edges. The scar is scarcely visible.

CASE 4. Infantryman Im N. of above hospital, sustained gunshot wound at the ear (Figs 7 and 8). After excision of the scar the wound edges were correctly placed opposite each other and sewn together. The result was as shown very beautiful.

CASE 5. Infantryman S. of Royal Reserve Hospital No 17 Vienna (Central hospital for jaw injuries). Shot through the under lip and jaw. Wound healed with deep lip and jaw scar with loss of movement (Figs 9 and 11). Complete excision of the scar and all its branches was done. The red of the lip was reconstructed with great care. This belongs to one of the most difficult tasks in plastics if a good cosmetic result is to be of attained. The deep sutures bring the skin and mucous membrane together so that they are approximated without tension.



Figs 18 and 19 Case 8 Penetrating gunshot wound of the lower lip

Figs 20 and 21 Case 9 Upper lip injury

CASE 6. Soldier S. Vereins Reserve Hospital No 1 in Brunn. Jaw cheek injury. After a long healing process complicated by erysipelas with ejection of many important jaw fragments the deep wound had finally decreased considerably and was firmly scarred (Figs 12 to 14). After excision of the extensive scars the sewing of the muscles was carefully done and with it an underlay was formed for the sewing of the skin which followed.

CASE 7. Infantryman Z. Royal Reserve Hospital No 2 in Brunn. Defect of the upper lip (Figs 15 to 17). This case was similar to Case 3 in reference to the deep sutures in mobilized tissue which bring together the superficial wound edges and at the same time raise them to the right level. Figure 16 shows that the repaired upper lip

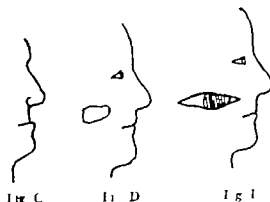


Fig C

Fig D

Fig E



Fig 22. Case 1. Upper eyelid gunshot defect.  
Fig 23. Case 2. Unshot wound of cheek and  
no

Figs 26 and 27. Case 3. Injury to lower half of right  
ear and right of cheek.

Figs 28, 29, and 30. Case 4. Corrected wound of skull after  
trepanning, and scar after injury to lower jaw.

has become the entire front of the face by this method and it is  
that has not fallen back so often the case is repaired  
hardly. The cases are usually recognizable as such from afar.  
Anneted II trait on Fig C shows this condition as  
badly treated hard.

CASE 8. Infantryman I. Royal Reserve II. 1st N. 8  
in Vienna had penetrating wound of upper jaw gunshot  
resulting in pseudarthrosis and soft part scar. The  
latter entirely rounded the chin. Was removed by ex-  
cision and repaired by nasal cartilage (Figs 28 and 29).

CASE 9. Soldier D. Royal Reserve. Hospital N. 7 in  
Vienna suffered vertical split of the upper lip from

gunshot wound of chin after the repair healed leaving no  
trace (Figs 30 and 31).

CASE. The same Infantryman I. S. Royal  
Reserve. Hospital N. Bruen. He had an upper  
eyelid gunshot defect which was improved by excision of  
broad parts and making smaller eyelids (Figs 32 and 33).

#### 8. SIMPLE LINEAL SEAM AFTER SCAR AND BURN EXCISION

CASE. Infantryman 7. Royal Reserve. Hospital  
N. Bruen. Unshot wound of cheek and no  
result in the scar. The cases were both cut out (Figs 34 and 35).



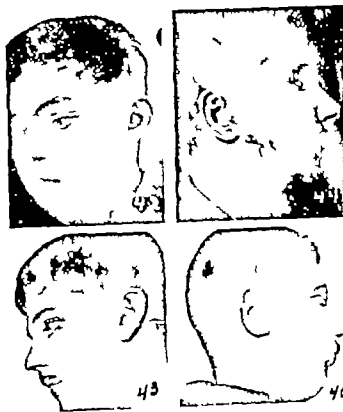
Figs 32 and 33 Case 14 Shot through cheek and adjoining nostril Fig 33 shows the final result

Figs 34 to 4 Cases 15 and 16 Correction of deep broad cheek scar (figs 34 and 35) and deep fixed temple scar (Figs 36 to 41)

F) Because the cheek wound was too nearly round it was lengthened by excision of normal cheek skin. A large piece of adjacent subcutaneous tissue was removed to imitate there the condition of the original wound the scars of which had been excised. The entire wound was then closed with equal tension (Figs 24 and 25). In this case I had to be careful on account of the Stensen's duct and facial nerve. The scar on the nose was repaired by a small pedicle flap (Figs 4 and 2).

CASE 12 Infantryman S. V. of the same hospital (Figs 26 and 27) had the lower half of his right ear and a part of the cheek shot away. The cheek defect was closed by lineal scar after the excision of healthy skin as in case above. He then gave good conditions for repair.

CASE 13 Similar procedure was followed in the case of Infantryman Fr. (the same hospital) to correct a scar fixed on the skull after trepanning. A soft part scar fixed on the lower part from another shot was also improved. On the forehead the closing of the bone defect was made with a pedicled bone flap (Figs 28 to 31).



Figs 43 to 45 Cases 17 and 18 Correction of deep lineal scar on cheek

## 2. COMPLICATED LINEAL SCAR WITH UNDERLAY FROM DIRECT NEIGHBORHOOD

CASE 14 Infantryman J. P. Verena Reserve Hospital No. 1 in Brunn was shot through the cheek and adjoining nostril (Figs 32 and 33). I prepared the plastic for this by